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The last two publications form the foundation of the present volume.

A

HANDBOOK

FOR

FARMERS AND DAIRYMEN.

BY

F. W. WOLL,

Assistant Professor of Agricultural Chemistry,
University of Wisconsin.

WITH THE ASSISTANCE OF

WELL-KNOWN SPECIALISTS.

With Illustrations.

FIRST EDITION.

FIRST THOUSAND.

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PREFACE.

THE effort of the author has been to make this small volume a compendium of useful information on farm and dairy topics. Brief discussions on subjects of importance and interest to farmers and dairymen have been introduced, and useful facts, tables, formulas, receipts, agricultural statistics, etc., are given to such an extent as the plan of the work permitted. Valuable data scattered throughout our agricultural literature, in the reports and bulletins of our experiment station, and the scientific divisions of the United States Department of Agriculture, as well as in other public documents and in farm papers and standard works, have been gathered in this Handbook and arranged in such a manner as to make them easily accessible and convenient for reference purposes.

The present volume is a third edition of the Dairy and Agricultural Calendars previously published by the author. Much new material, both original and compiled, has been included, and special articles, tables, statistics, etc., have been verified, and brought up to date, making the book, as it is hoped, of considerable value, and securing for it as favorable reception and as enthusiastic friends as its predecessors found.

The author takes this opportunity of thanking the following able writers and specialists who have so materially

increased the usefulness of the book by comprehensive, concise contributions on subjects in their particular lines of study: Professors W. H. Caldwell, J. A. Craig, L. H. Dewey, F. H. Farrington, B. E. Fernow, E. S. Goff, G. H. Hicks, A. W. Richter, H. L. Russell, Thos. Shaw, Wm. P. Wheeler; and Messrs. John Boyd, W. G. Clark, M.D.C., John W. Decker, N. S. Fish, J. D. Frederiksen, H. B. Gurler, S. Hoxie, J. Noer, M.D., J. H. Pickrell, H. B. Richards, L. P. Sisson, J. McLain Smith, and C. M. Winslow.

While all possible care in the preparation of the manuscript and in the proof-reading of the book has been taken, it cannot be expected that errors have been entirely avoided, and readers discovering any such will confer a favor by communicating them to the author.

F. W. Woll.

Agricultural Experiment Station,
Madison, Wis., February, 1897.

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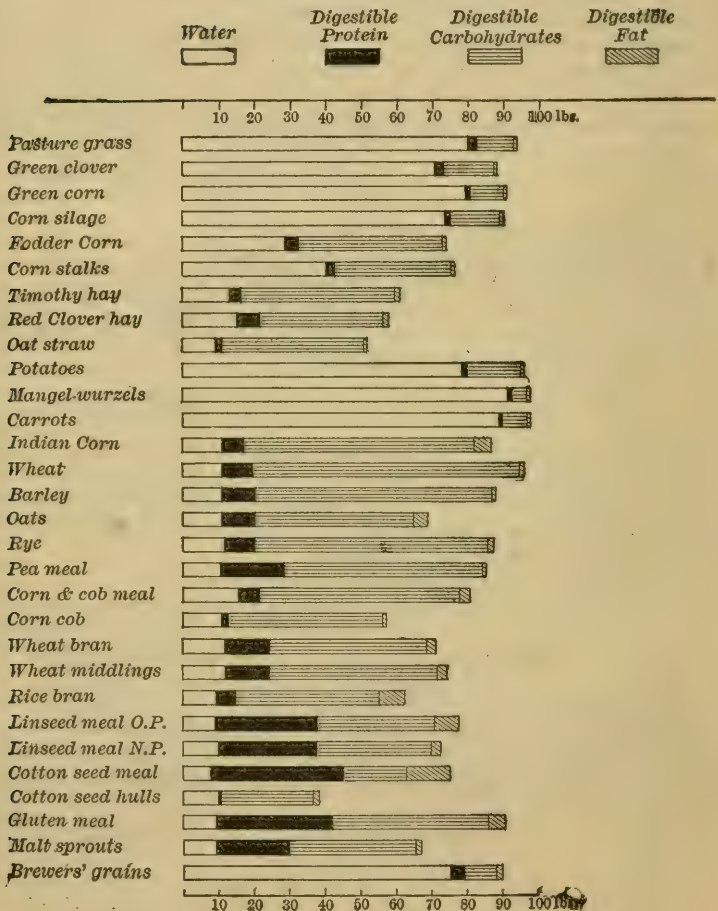
COMPOSITION OF FEEDING STUFFS.

Chart showing Pounds of Water and of Digestible Matter in 100 lbs.



PART I. AGRICULTURE.

I. FEEDING STUFFS.

COMPOSITION OF FEEDING STUFFS.

In the ordinary chemical analysis of feeding stuffs the following constituents are determined, viz., water, ash, protein, crude fiber, nitrogen-free extract, ether extract (fat).

Water is present in all feeding stuffs, from above 90 per cent in green foods and some kinds of roots, to below 10 per cent in very dry hay and in concentrated food stuffs.

Ash, or mineral matter, is the non-combustible part of plants, and goes to make the bones of the animal, or to supply material for the maintenance of other parts of the animal body.

Protein is the name of a large group of substances, all characterized by the fact that they contain the element nitrogen; hence they are also called *nitrogenous* substances; and foods rich in protein are spoken of as *nitrogenous foods*. The protein substances supply the material necessary for the formation of lean meat, ligaments, tendons, hair, horns, hoofs, etc., and also of casein of the milk. Crude protein includes *albuminoids* and *amides;* among the former are found white of egg, lean meat, curd of milk and gluten; among the latter, asparagin and other crystallizable and water-soluble substances, generally speaking, of a somewhat inferior nutritive value.

Crude Fiber or woody fiber is the framework of plants, forming the walls of their cells; it is usually the least digestible portion of feeding stuffs, and the nutritive value of a plant is decreased as its crude fiber content increases.

Nitrogen-free Extract includes starch, sugar, gums, organic acids, etc., and forms a most important and usually a very large part of cattle foods. Together with cellulose, nitrogen-free extract forms the group of bodies called *carbo-*

hydrates. A general name for carbohydrates is *heat-producing substances*, as against *flesh-forming substances*, i.e., nitrogenous compounds, the names indicating the main offices of the substances in animal nutrition.

Ether Extract, or *crude fat* (*oil*) includes a group of compounds dissolved out by ether in the analysis of foods; fat forms the main part of the extract; most feeding stuffs contain only a small quantity of fat, but this component is nevertheless of considerable importance in the feeding of animals.

Organic Matter signifies the combustible portion of chemically dry feeding stuffs, i.e., all the components given in the preceding except water and ash.

Digestible Components.—The food stuffs used in the feeding of farm animals are only partly of direct value to the animals, the portion which their digestive fluids are unable to dissolve being voided in the excrements. The digestibility of fodders has been determined by direct experiments with different kinds of farm animals, in this country or abroad. The *digestion coefficients* (see pp. 6–8) mean the percentages of any one component which have been found to be digested by the animals experimented on.

Nutritive Ratio signifies the ratio between the digestible nitrogenous and non-nitrogenous components in a feeding stuff, or a combination of such. As fat has been found to yield about 2.2 times more heat, when burned, than do starch, sugar, and other carbohydrates, the per cent of digestible fat in a food is multiplied by 2.2 when the nutritive ratio is to be calculated; the product is added to the per cent of digestible carbohydrates (nitrogen-free extract + crude fiber), and this sum is divided by the per cent of digestible protein. (The factor $2\frac{1}{2}$ or $2\frac{1}{4}$ is sometimes used for obtaining "the starch equivalent" of fat.)

Example: Clover hay contains on the average 6.5 per cent digestible protein, 34.9 per cent digestible carbohydrates, and 1.6 per cent digestible fat (see following table):

$$1.6 \times 2.2 = 3.52; \quad 34.9 + 3.52 = 38.42; \quad 38.42 \div 6.5 = 5.9.$$

Nutritive ratio, 1 : 5.9.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.

Feeding Stuffs.	No. of Analyses.	Percentage Composition.* Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.	Organic Matter.	Per cent Digestible Matter. Crude Protein.	Carbohydrates.	Ether Extract.
Green Fodders and Silage.											
Pasture grass	...	80.0	2.0	3.5	4.0	9.7	.8	18.0	2.6	10.6	.5
Green fodder corn (maize)	126	79.3	1.2	1.8	5.0	12.2	.5	19.5	1.3	11.8	.4
Alfalfa (lucern)	23	71.8	2.7	4.8	7.4	12.3	1.0	25.5	3.6	11.4	.4
Green clover	43	70.8	2.1	4.4	8.1	13.5	1.1	27.1	2.9	14.1	.7
Alsike clover, in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	23.2	2.7	13.1	.6
Rye fodder	7	76.6	1.8	2.6	11.6	6.8	.6	21.6	2.1	14.1	.4
Oat fodder	5	62.2	2.5	3.4	11.2	19.3	1.4	35.3	2.7	22.7	1.0
Sorghum fodder	11	79.4	1.1	1.3	6.1	11.6	.5	19.5	.8	12.7	.4
Red top, in bloom	5	64.8	2.3	3.3	9.4	19.1	1.2	32.9	2.3	20.5	.7
Meadow fescue, in bloom	4	69.9	1.8	2.4	10.8	14.3	.8	28.3	1.7	17.8	.5
Timothy	56	61.6	2.1	3.1	11.8	20.2	1.2	36.3	2.2	23.0	.7
Blue-grass	81	65.1	2.8	4.1	9.1	17.6	1.3	32.1	2.9	19.2	.8
Prickly comfrey	41	88.4	2.2	2.4	1.6	5.1	.3	9.4	1.4	4.6	.2
Corn silage	99	79.1	1.4	1.7	6.0	11.1	.8	19.5	.8	11.6	.7
Corn silage, Wis. anal.	17	73.6	2.1	2.7	7.8	12.9	.9	24.2	1.3	14.0	.7
Clover silage	5	72.0	2.6	4.2	8.4	11.6	1.2	25.4	2.0	13.5	1.0
Sorghum silage	6	76.1	1.1	.8	6.4	15.3	.3	22.8	.6	14.9	.2
Hay and Dry Coarse Fodders.											
Fodder corn (maize), field cured	35	42.2	2.7	4.5	14.3	34.7	1.6	55.1	2.6	33.3	1.1
Same, Wis. analyses	5	29.0	4.2	6.5	22.1	36.5	1.7	66.8	3.7	40.4	1.2
Corn stalks (stover), field cured	60	40.1	3.4	3.8	19.7	31.9	1.1	56.5	2.0	33.4	.6
Hay from red clover	38	15.3	6.2	12.3	24.8	38.1	3.3	78.5	6.5	34.9	1.6
Hay from mammoth clover	10	21.2	6.1	10.7	24.5	33.6	3.9	72.7	5.7	32.0	1.9
Hay f'm alfalfa (lucern)	21	8.4	7.4	14.3	25.0	42.7	2.2	84.2	7.6	37.8	1.3
Hay from alsike clover.	9	9.7	8.3	12.8	25.6	40.7	2.9	82.0	6.8	36.8	1.4
Oat hay	6	8.9	6.2	7.6	29.3	45.1	2.9	84.9	4.3	46.4	1.5
Timothy hay	68	13.2	4.4	5.9	29.0	45.0	2.5	82.4	3.0	43.9	1.2
Hay from mixed meadow grasses	11	16.0	4.6	6.4	29.9	41.0	2.1	79.4	3.6	42.7	1.0
Hay from Hun. grass	12	7.7	6.0	7.5	27.7	49.0	2.1	86.3	4.5	46.4	1.0
Marsh hay	2	7.9	5.2	7.8	30.1	46.3	2.7	86.9	3.5	44.7	1.7
Oat straw	12	9.2	5.1	4.0	37.0	42.4	2.3	85.7	1.6	41.4	.7
Barley straw†	97	14.2	5.7	3.5	36.0	39.0	1.5	80.1	.9	41.3	.6
Wheat straw	7	9.6	4.2	3.4	38.1	43.4	1.3	86.2	.8	37.9	.5
Rye straw	7	7.1	3.2	3.0	38.9	46.6	1.2	89.7	.8	42.7	.4
Buckwheat straw	3	9.9	5.5	5.2	43.0	35.1	1.3	84.6	2.3	37.7	.6
Pea vine†	14	13.6	6.6	9.0	35.5	33.7	1.6	79.8	4.3	32.3	.8

* Largely from Jenkins and Winton's Compilation of Analyses of American Feeding Stuffs. † König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.—*Continued.*

Feeding Stuffs.	No. of Analyses.	Percentage Composition.							Per cent Digestible Matter.		
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohydrates.	Ether Extract.
Roots and Tubers.											
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	20.1	1.4	16.1	.1
Sweet potatoes	6	71.1	1.0	1.5	1.3	24.7	.4	27.9	.9	22.2	.3
Red beets	9	88.5	1.0	1.5	.9	8.0	.1	10.5	.9	7.6	.1
Sugar beets	19	86.5	.9	1.8	.9	9.8	.1	12.6	1.1	9.3	.1
Mangel-wurzels	9	90.9	1.1	1.4	.9	5.5	.2	8.0	1.1	4.8	.2
Rutabagas	4	88.6	1.2	1.2	1.3	7.5	.2	10.2	.9	7.1	.2
Turnips	3	90.5	.8	1.1	1.2	6.2	.2	8.7	.6	5.5	.2
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	10.4	1.0	7.1	.3
Grains and Flour Mill Products.											
Corn (maize)	208	10.9	1.5	10.5	2.1	69.6	5.4	87.6	6.3	64.8	5.0
Corn and cob meal	7	15.1	1.5	8.5	6.6	64.8	3.5	83.4	6.5	56.3	2.9
Corn cob	18	10.7	1.4	2.4	30.1	54.9	.5	87.9	1.6	43.9	.3
Corn bran (hulls)	5	9.1	1.3	9.0	12.7	62.2	5.8	89.6	7.4	59.8	4.6
Oats	30	11.0	3.0	11.8	9.5	59.7	5.0	86.0	9.1	44.7	4.1
Oat shorts*	6	10.0	5.2	16.2	7.5	54.5	6.6	84.8	12.6	45.7	5.4
Oat feed	4	7.7	3.7	16.0	6.1	59.4	7.1	88.6	12.5	46.9	2.8
Oat dust	2	6.5	6.9	13.5	18.2	50.2	4.8	86.6	8.9	38.4	5.1
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	86.7	9.5	66.1	1.2
Barley screenings	2	12.2	3.6	12.3	7.3	61.8	2.8	84.2	9.3	57.3	1.8
Wheat	310	10.5	1.8	11.9	1.8	71.9	2.1	87.7	9.2	64.9	1.4
Wheat bran—roller process	7	12.0	5.6	16.1	8.4	53.7	4.2	82.4	12.6	44.1	2.9
Wheat bran—old process	9	12.0	4.9	13.0	8.1	58.2	3.8	83.1	10.1	47.5	2.6
Wheat shorts	12	11.8	4.6	14.9	7.4	56.8	4.5	83.6	11.6	45.4	3.2
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	84.5	12.2	47.2	2.9
Wheat screenings	10	11.6	2.9	12.5	4.9	65.1	3.0	85.5	9.8	51.0	2.2
Low-grade flour ("red dog")	8	10.0	2.2	15.8	1.6	67.7	2.7	87.8	13.5	61.3	2.0
Rye	6	11.6	1.9	10.6	1.7	72.5	1.7	86.5	8.3	65.5	1.2
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	84.8	9.7	48.0	1.6
Rye shorts	1	9.3	5.9	18.0	5.1	59.9	2.8	85.8	11.9	45.1	1.6
Buckwheat	8	12.6	2.0	10.0	8.7	64.5	2.2	85.4	7.7	49.2	1.8
Buckwheat bran	2	10.5	3.0	12.4	31.9	38.8	3.3	86.5	7.4	30.4	1.9
Buckwheat shorts	2	11.1	5.1	27.1	8.3	40.8	7.6	83.8	21.1	33.5	5.5
Buckwheat middlings	6	12.7	5.1	28.2	4.2	42.3	7.5	82.2	22.0	33.4	5.4
Rice	10	12.4	.4	7.4	.2	79.2	.4	87.2	4.8	72.2	.3
Rice bran	5	9.7	10.0	12.1	9.5	49.9	8.8	80.3	5.3	45.1	7.3
Rice hulls	3	8.2	13.2	3.6	35.7	38.6	.7	78.6	1.6	44.5	.6
Rice polish	4	10.0	6.7	11.7	6.3	58.0	7.3	83.3	9.0	56.4	6.5
Pea meal	2	10.5	2.6	20.2	14.4	51.1	1.2	86.9	18.0	56.0	.9

* König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.—*Continued.*

Feeding Stuffs.	No. of Analyses.	Percentage Composition. Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.	Organic Matter.	Per cent Digestible Matter. Crude Protein.	Carbohydrates.	Ether Extract.
Sorghum seed...... ...	10	12.8	2.1	9.1	2.6	69.8	3.6	85.1	7.0	52.1	3.1
Cow pea.	5	14.8	3.2	20.8	4.1	55.7	1.4	82.0	18.3	54.2	1.1
Soja bean.............	8	10.8	4.7	34.0	4.8	28.8	16.9	84.5	29.6	17.9	15.9
Miscellaneous Feeds.											
Malt sprouts...........	5	9.6	5.9	24.8	11.0	47.0	1.7	84.5	19.8	36.2	1.7
Brewers' grains, wet ..	15	75.7	1.0	5.4	3.8	12.5	1.6	23.3	3.9	9.5	1.3
Brewers' grains, dried.	5	7.7	3.6	22.2	12.3	47.9	6.3	88.7	16.2	35.5	5.3
Hominy chops (meal)..	14	10.9	2.5	9.9	3.7	64.4	8.5	86.6	8.9	61.0	7.8
Gluten feed..	7	8.3	.9	21.6	6.8	49.6	12.7	90.8	18.6	48.3	11.1
Cream gluten meal	5	8.2	1.3	32.8	1.7	42.0	14.1	90.5	29.5	39.6	12.8
Chicago gluten meal...	3	9.5	.9	35.8	1.5	46.8	5.6	89.6	32.2	44.1	5.1
Corn oil cake..........	3	9.0	2.4	24.8	6.7	43.6	13.5	88.6	22.3	42.6	12.3
Germ meal (corn germ)	4	10.4	3.6	10.0	5.0	64.2	6.8	86.0	9.0	61.2	6.2
Grano-gluten..........	3	5.7	2.7	31.0	11.4	34.8	14.2	91.6	26.7	38.8	12.4
Starch feed, wet.......	12	65.4	.3	6.1	3.1	22.0	3.1	34.3	5.5	21.7	2.3
Cotton-seed meal.......	37	8.2	7.2	42.4	5.6	23.8	12.9	84.6	36.9	18.1	12.3
Cotton-seed hulls......	10	9.9	2.9	4.2	47.4	33.2	2.2	87.2	1.0	26.2	1.8
Linseed meal, old process.................	21	9.2	5.7	32.9	8.9	35.4	7.9	85.1	28.3	32.8	7.1
Linseed meal, new process.................	14	10.1	5.8	33.2	9.5	38.5	3.0	84.1	27.2	32.9	2.7
Palm-nut meal*........	600	10.4	4.3	16.8	24.0	35.0	9.5	85.3	16.0	52.6	9.0
Apples*........	36	84.8	.5	.4	1.5	12.5	.3	14.7	.3	12.8	.2
Apple pomace	7	76.7	.5	1.4	3.9	16.2	1.3	22.8	1.0	11.9	1.1
Meat-scraps*..........	144	10.7	4.1	71.2	....	.3	13.7	85.2	68.4	.3	13.5
Dried blood*...........	3	8.5	4.7	84.4	....	....	2.5	86.8	58.1	....	2.3
Skimmed milk*.........	96	90.4	.7	3.3	....	4.7	.8	8.9	3.1	4.7	.8
Buttermilk*...........	85	90.1	.7	4.0	....	4.0	1.1	9.2	3.9	4.0	1.1
Whey*................	46	93.4	.7	.9	...	4.8	.3	5.9	.8	4.7	.3

* König.

AVERAGE AMERICAN DIGESTION COEFFICIENTS OF FEEDING STUFFS

As Determined by American Experiments. (JORDAN.)

	No. States.	No. Samples.	Single Trials.	Dry Matter.	Ash.	Protein (N.×6.25).	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.
A.—EXPERIMENTS WITH RUMINANTS.									
GREEN FODDER (fed when green).									
Corn (maize) fodder—									
Whole plant, average of all trials. ..	2	15	30	68	35	61	61	74	74
Dent, immature, Pennsylvania	1	4	9	68	57	69	69	71	66
in milk, Pennsylvania.........	1	3	6	68	33	62	63	73	76
mature, Pennsylvania.........	1	7	13	67	22	53	54	75	78
Sorghum, North Carolina and Texas..	2	2	4	67	42	47	59	74	74
Rye, Pennsylvania....................	1	1	2	73	56	79	79	70	74
Timothy (*Phleum pratense*), Utah.....	1	1	3	63	32	48	56	66	53
Hungarian grass (*Setaria italica*), Me.	1	1	4	63	41	62	68	66	52
Pasture grass, Pennsylvania...	1	1	1	69	50	65	74	72	55
Red clover (*Trifolium pratense*)......	1	1	2	66	55	67	53	78	64
SILAGE.									
Corn (maize) silage, whole plant—									
Average of all kinds.................	6	17	37	66	31	53	67	70	81
Dent, immature, Maine, New York and Pennsylvania...............	3	5	12	64	33	49	71	66	75
Dent, in milk, Pennsylvania....	1	3	8	65	32	50	65	69	87
Flint mature, Maine and New York.	2	4	10	73	30	63	75	77	83
Soja-bean silage..............	1	1	2	59	57	76	55	52	72
DRIED FODDERS (fed air-dry or partially so).									
Corn (maize) fodder, whole plant—									
Average of all kinds	4	24	50	66	34	55	66	69	72
Dent, immature, Maine and Penn...	2	6	12	62	38	51	67	64	68
in milk, New York and Penn..	2	5	12	63	31	45	64	66	76
mature, Pennsylvania.........	1	4	6	70	20	55	52	77	79
Flint, mature, Maine................	1	4	9	71	42	65	76	73	70
Sweet, mature, Maine...............	1	3	6	67	36	64	74	68	74
Corn (maize) butts, Maryland..........	1	1	2	66	11	21	73	69	79
husks, Maryland....... ...	1	1	2	72	16	29	79	75	32
fodder, tops above ear, Maryland...	1	1	2	55	7	22	70	53	63
pulled, Maryland, North Carolina and Texas.....	3	3	6	60	....	51	69	63	64
stover, Pennsylvania	1	1	4	62	45	52	66	64	52
Sorghum fodder, leaves, N. Carolina..	1	1	2	63	29	61	70	64	47
Oat straw, Maine.......	1	1	2	50	....	....	58	53	38

AVERAGE DIGESTION COEFFICIENTS.—*Continued.*

	No. States.	No. Samples.	Single Trials.	Dry Matter.	Ash.	Protein (N. × 6.25).	Crude Fiber.	Nitrogen free Extract.	Ether Extract.
A.—EXPRTS. WITH RUMINANTS—Cont.									
DRIED FODDERS—Continued.									
Hay from grasses named:									
Barley, Maine	1	1	4	61	45	65	62	63	40
Blue joint (*Calamagrostis canadensis*), Maine	1	2	3	54	29	63	54	56	45
Cat-tail millet (*Pennisetum spicatum*), North Carolina	1	1	2	62	68	63	66	59	46
Hungarian grass (*Setaria italica*), Maine	1	1	2	65	47	60	68	67	64
Johnson grass (*Sorghum halepense*), North Carolina	1	1	1	54	56	45	58	54	39
Orchard grass (*Dactylis glomerata*), Maine and New York	2	2	3	56	...	59	60	55	54
Redtop (*Agrostis vulgaris*), Maine	1	2	3	60	29	61	61	62	50
Timothy (*Phleum pratense*), average of all kinds, Maine and Utah	2	10	22	58	37	49	53	63	57
ditto, in full bloom, Maine	1	3	5	61	44	57	59	64	56
ditto, late cut, Maine	1	3	5	54	32	45	48	61	51
Wild-oat grass (*Danthonia spicata*), Maine	1	2	2	64	35	58	68	65	50
Witch-grass (*Triticum repens*), Me.	1	2	3	61	41	58	63	65	57
Pasture grass, Pennsylvania	1	2	3	72	52	73	76	74	67
Mixed grasses, New York and Penn.	3	4	9	56	....	51	55	59	52
Hay from legumes named:									
Alfalfa, Colorado, and New York	2	2	3	58	....	73	46	68	51
Alsike clover (*Trifolium hybridum*), Maine	1	2	3	62	52	66	53	71	50
Crimson clover (*Trifolium incarnatum*), North Carolina	1	1	2	61	53	69	46	70	46
Red clover (*Trifolium pratense*), Maine and Wisconsin	2	2	7	53	....	52	47	61	48
White clover (*Trifolium repens*), Me.	1	1	1	66	58	73	61	69	51
Cowpea vines, North Carolina	1	1	2	59	49	65	42	71	52
Soja-bean vines, North Carolina	1	1	2	62	....	71	61	69	29
MISCELLANEOUS FODDERS.									
Buttercup hay (*Ranunculus acris*), Me.	1	1	1	56	48	56	41	67	70
Peanut-vine hay, North Carolina	1	1	2	60	20	63	52	69	66
Sorghum bagasse, North Carolina	1	1	1	61	13	14	46	65	64
White weed, white daisy (*Chrysanthemum leucanthemum*), Maine	1	1	1	58	52	58	45	57	62
ROOTS.									
Sugar-beets, Maine	1	1	2	94	32	91	100	100	50
Mangel-wurzels, Maine	1	1	2	78	16	75	43	91	...

AVERAGE DIGESTION COEFFICIENTS.—*Continued.*

	No. States.	No. Samples.	Single Trials.	Dry Matter.	Ash.	Crude Protein (N.×6.25).	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.
A.—EXPRTS. WITH RUMINANTS—Cont.									
ROOTS—Continued.									
Rutabagas, Maine	1	1	2	87	31	80	74	95	84
Turnips (strap-leaf), Maine	1	1	2	93	59	90	100	96	97
Potatoes, Maine	1	1	3	77	...	44	...	91	13
GRAINS (fed whole or ground).									
Corn and cob meal, North Carolina	1	1	3	79	....	52	45	88	84
Corn meal, North Carolina and N. Y.	2	2	5	87	....	60	....	92	92
Cotton seed, raw, North Carolina	1	1	2	66	43	68	75	50	87
roasted, North Carolina	1	1	2	56	....	47	66	51	72
Pea meal, Maine	1	1	2	87	44	83	26	94	54
BY-PRODUCTS.									
Brewers' grains, dried, Massachusetts	1	1	2	62	....	79	53	59	91
Corn cobs, Massachusetts	1	1	2	59	....	17	65	60	50
Cotton-seed hulls, N. Car. and Texas	2	3	11	41	24	10	38	40	77
meal, N. Car. and Wis	2	2	7	76	...	88	....	64	97
Gluten feed (Buffalo), Massachusetts	1	1	2	78	....	85	43	81	81
meal, Maine	1	1	2	87	....	87	...	91	88
Linseed meal, new process, Mass	1	1	2	81	....	87	61	86	91
old process, Mass	1	1	2	79	....	89	57	78	89
Malt sprouts, Wisconsin	1	1	1	67	....	80	33	68	100
Wheat bran, Maine and Massachusetts;	2	4	7	61	....	78	25	68	72
middlings, Maine and Mass	2	2	4	79	....	82	....	88	85
B.—EXPERIMENTS WITH SWINE.									
GRAINS AND BY-PRODUCTS.									
Barley, Minnesota	1	1	1	80	5	81	48	87	67
Corn (maize) (whole kernel), Maine and Minnesota	2	2	2	86	....	79	44	91	62
meal, Maine	1	1	1	89	....	86	29	94	82
Corn and cob meal, Maine	1	1	1	76	....	76	28	84	82
Peas, Minnesota	1	1	1	90	40	89	78	95	50
Wheat shorts, Minnesota	1	1	2	76	5	73	36	87	...
Wheat bran, Minnesota	1	1	2	61	....	75	33	66	72

CLASSIFICATION OF CATTLE FOODS. (Lindsey.)

Coarse Feeds.			Concentrated Feeds.	
1	2	3	4	5
Low in protein. High in carbohydrates. 50 to 65 per cent digestible.	Medium in protein. Medium in carbohydrates. 55 to 65 per cent digestible.	Low in protein. High in carbohydrates. 85 to 95 per cent digestible.	Low in protein. High in carbohydrates. 80 to 90 per cent digestible.	High in protein. Medium in carbohydrates. 80 to 90 per cent digestible.
Hays, straws, corn fodder, corn stover, and silage.	Clovers, vetches, pea and bean fodders and brans.	Carrots, potatoes, sugar beets, mangolds, turnips.	Wheat, rye, barley, oats, Indian corn.	Bean and pea meals, gluten feeds and meals, linseed meals and cotton-seed meal.

CLASSIFICATION OF CONCENTRATED FEED STUFFS.

Very rich in protein (above 40 per cent).	Rich in protein (25-40 per cent).	Fairly rich in protein (12-25 per cent).	Poor in protein (below 12 per cent).
Dried blood. Meat scraps. Cotton-seed meal.	Gluten meal. Atlas meal. Linseed meal. Buckwheat middlings. Buckwheat shorts Soja bean. Grano-gluten.	Malt sprouts. Dried brewers' grains. Gluten feed. Cow pea. Pea meal. Wheat shorts. Rye shorts. Oats shorts. Wheat middlings. Wheat bran. Low-grade flour.	Wheat. Barley. Oats. Rye. Corn. Rice polish. Rice. Hominy chops. Germ meal.

FEEDING STANDARDS FOR FARM ANIMALS.

(WOLFF.)

(Per day and per 1000 lbs. live weight.)

	Aver. live weight per head.	Total Organic Substance.	Nutritive (Digestible) Substances. Crude Protein.	Carbo-hydrates.	Ether Extract.	Total Nutritive Substances.	Nutritive Ratio.
		lbs.	lbs.	lbs.	lbs.	lbs.	
1. Steers at rest in stall		17.5	0.7	8.0	0.15	8.85	1:12
2. Steers moderately worked		24.0	1.6	11.3	0.30	13.20	1:7.5
Steers heavily worked		26.0	2.4	13.2	0.50	16.10	1:6.0
3. Milch cows		24.0	2.5	12.5	0.40	15.40	1:5.4
4. Horses lightly worked		20.0	1.5	9.5	0.40	11.40	1:7.0
Horses moderately worked		21.0	1.7	10.4	0.60	12.70	1:7.0
Horses heavily worked		23.0	2.3	12.5	0.80	15.60	1:6.0
5. Wool sheep, coarser breeds		20.0	1.2	10.3	0.20	11.70	1:9.0
" " finer breeds		22.5	1.5	11.4	0.25	13.15	1:8.0
6. Fattening steers, 1st period		27.0	2.5	15.0	0.50	18.00	1:6.5
" " 2d "		26.0	3.0	14.8	0.70	18.50	1:5.5
" " 3d "		25.0	2.7	14.8	0.60	18.10	1:6.0
7. Fattening sheep, 1st period		26.0	3.0	15.2	0.50	18.70	1:5.5
" " 2d "		25.0	3.5	14.4	0.60	18.50	1:4.5
8. Fattening swine, 1st period		36.0	5.0	27.5		32.50	1:5.5
" " 2d "		31.0	4.0	24.0		28.00	1:6.0
" " 3d "		23.5	2.7	17.5		20.20	1:6.5
9. Growing cattle:							
Age, Months.	*Aver. live weight per head.*						
2–3	165 lbs	22.0	4.0	13.8	2.0	19.8	1:4.7
3–6	330 "	23.4	3.2	13.5	1.0	17.7	1:5.0
6–12	550 "	24.0	2.5	13.5	0.6	16.6	1:6.0
12–18	770 "	24.0	2.0	13.0	0.4	15.4	1:7.0
18–24	940 "	24.0	1.6	12.0	0.3	13.9	1:8.0
10. Growing sheep:							
5–6	62 lbs	28.0	3.2	15.6	0.8	19.6	1:5.5
6–8	73 "	25.0	2.7	13.3	0.6	16.6	1:5.5
8–11	84 "	23.0	2.1	11.4	0.5	14.0	1:6.0
11–15	90 "	22.5	1.7	10.9	0.4	13.0	1:7.0
15–20	95 "	22.0	1.4	10.4	0.3	12.1	1:8.0
11. Growing fat pigs:							
2–3	55 lbs	42.0	7.5	30.0		37.5	1:4.0
3–5	110 "	34.0	5.0	25.0		30.0	1:5.0
5–6	137 "	31.5	4.3	23.7		28.0	1:5.5
6–8	187 "	27.0	3.4	20.4		23.8	1:6.0
8–12	275 "	21.0	2.5	16.2		18.7	1:6.5

RATIONS FOR DAIRY COWS.

	Org'nic Matter.	Digestible.				Nut. Ratio.
		Protein	Carbo-hydrates	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	
Woods & Phelps.......	25.0	2.5	12.5	.65	15.65	1:5.6
Woll....................	24.5	2.2	13.3	.7	16.2	1:6.9
Wolff's German Stand'.	24.0	2.5	12.5	.4	15.4	1:5.4

CALCULATION OF COMPONENTS OF FEED RATIONS.

Let us suppose that we have at our disposal the following common feeding stuffs: Fodder corn, clover hay, and wheat bran, and that we want to know how much is required to keep a milch cow of 1000 lbs. live weight in good condition and to secure a maximum yield of milk. We will feed 14 lbs. of fodder corn, 6 lbs. of clover hay, and 10 lbs. of wheat bran. According to the table these quantities contain the following number of pounds of digestible matter:

	Organic Matter.	Digestible.		
		Protein.	Carbo-hydrates.	Ether Extract.
	lbs.	lbs.	lbs.	lbs.
14 lbs. of field-cured fodder corn	9.35	.52	5.66	.17
6 lbs. clover hay................	4.71	.39	2.09	.10
10 lbs. wheat bran...............	8.24	1.26	4.41	.29
Total.....................	22.30	2.17	12.16	.56

This ration falls somewhat short of the feeding standard in total organic matter and digestible substances. To bring it nearer to the standard, we add a couple of pounds of some concentrated feed. In selecting the foods and deciding the quantities to be given in each case, the market prices of the feeds must be considered. We will suppose that a lot of corn-meal is available in this case, and will add two pounds of this feed to the above ration.

	Organic Matter.	Digestible.			Nutritive Ratio.
		Crude Protein	Carbohydrates.	Ether Extract	
	lbs.	lbs.	lbs.	lbs.	
Ration as above..................	22.30	2.17	12.16	.56	
2 lbs. of corn meal...........	1.75	.14	1.25	.08	
Total....	24.05	2.31	13.41	.64	1:6.4
Proposed American feeding ration for milch cows.....	24.5	2.2	13.3	.7	1:6.9
Wolff's feeding standard for milch cows...............	24.0	2.5	12.5	.4	1:5.4

The ration now corresponds very well with the proposed American feeding ration; there is a small deficit of organic matter and of digestible fat ; but there is no necessity of trying to follow any standard ration blindly, as they are only intended to be approximate gauges which the farmer may use in estimating the quantities of nutrients required by farm animals in order to do their best, cost and product both being considered.

In constructing rations according to the above feeding standards, several points must be considered besides the chemical composition and the digestibility of the feeding stuffs ; the standards cannot be followed directly without regard to bulk and other properties of the fodder ; the ration must not be too bulky, and still must contain a sufficient quantity of roughage to keep up the rumination of the animals, in case of cows and sheep, and to secure a healthy condition of the animals generally. The local market prices of cattle foods are of the greatest importance in determining which foods to buy ; the conditions in the different sections of our great continent differ so greatly in this respect that no generalizations can be made. Generally speaking, nitrogenous concentrated feeds are the cheapest feeds in the South and the East, and flour-mill, brewery, and starch-factory refuse feeds the cheapest in the Northwest.

PRACTICAL RATIONS FOR DAIRY COWS.

Fed by 16 American Dairymen Producing 325 lbs. of Butter or more per Cow per Year.*

1. *Colorado.*—30 lbs. silage, 10 lbs. alfalfa hay, 10 lbs. clover hay, 5 lbs. wheat bran, 2 lbs. corn meal.

2. *Connecticut.*—35 lbs. corn silage, 10 lbs. hay, 3 lbs. wheat bran, 3 lbs. corn and cob meal, 2 lbs. cotton-seed meal, 2 lbs. Chicago gluten meal.

3. *Illinois.*—7½ lbs. clover hay, 7½ lbs. timothy hay, 12 lbs. corn and cob-meal, 8 lbs. bran, 1¼ lbs. linseed meal, 1¼ lbs. cotton-seed meal.

4. *New Jersey.*—24 lbs. corn silage, 8 lbs. corn meal, 2 lbs. wheat bran, 4 lbs. oats, 2 lbs. oil meal.

5. *New York.*—20 lbs. hay, 2 lbs. wheat bran, 2 lbs. cotton-seed meal, 2 lbs. hominy meal.

6. *New York.*—12 lbs. timothy hay, 1 lb. wheat bran, 1 lb. middlings, 2 lbs. corn meal, 2 lbs. cotton-seed meal, 40 lbs. skim-milk.

7. *New York.*—42 lbs. corn silage, 2½ lbs. clover hay, 2½ lbs. timothy hay, 8 lbs. corn and cob meal, 14 lbs. dried brewers' grains.

8. *North Carolina.*—30 lbs. corn silage, 8 lbs. fodder corn, 3 lbs. corn meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

9. *Pennsylvania.*—24 lbs. corn fodder, 5.1 lb. wheat bran, 5.1 lbs. corn meal, 3 lbs. cotton-seed meal, 2 lbs. oil meal.

10. *Pennsylvania.*—10 lbs. corn fodder, 6 lbs. hay, 3½ lbs. wheat bran, 1½ lbs. cotton-seed meal, 1½ lbs. oil meal, 2½ lbs. corn meal.

11. *Texas.*—30 lbs. corn silage, 13½ lbs. sorghum hay, 1.3 lbs. corn meal, 2.6 lbs. cotton-seed meal, 2.2 lbs. cotton-seed, 1.3 lbs. wheat bran.

12. *Vermont.*—30 lbs. corn silage, 10 lbs. hay, 4.2 lbs. corn meal, 4.2 lbs. wheat bran, .8 lb. linseed meal.

13. *West Virginia.*—48 lbs. corn silage, 2½ lbs. corn and cob meal, 2½ lbs. ground wheat, 2½ lbs. oats, 2½ lbs. barley meal.

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* See Woll, "One Hundred American Rations for Dairy Cows," Bulletin No. 38, Wisconsin Agricultural Experiment Station.

14. *Wisconsin.*—26 lbs. corn silage, 10 lbs. clover hay, 5 lbs. timothy hay, 8 lbs. wheat middlings, 1½ lbs. oil meal.

15. *Wisconsin.*—50 lbs. corn silage, 5 lbs. sheaf oats, 5 lbs. corn fodder, 1 lb. clover hay, 1 lb. millet, 2.7 lbs. cotton-seed meal, 1.3 lbs. oil meal, 6 lbs. wheat bran.

16. *Canada.*—40 lbs. corn silage, 7½ lbs. clover hay, 3 lbs. straw, 1⅓ lbs. oats, 1⅓ lbs. barley, 1⅓ lbs. pea meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

The preceding rations contain approximately the following amounts of nutrients, calculated for 1000 lbs. live weight:

No.	Organic Matter.	Digestible.				Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	31.09	2.70	15.78	.80	19.28	1 : 6.5
2	25.70	2.69	13.96	.97	17.62	1 : 6.0
3	22.09	2.37	12.06	.75	15.18	1 : 5.8
4	19.41	2.06	11.71	.87	14.64	1 : 6.5
5	26.19	2.36	13.78	.79	16.93	1 : 6.6
6	25.73	3.50	14.05	1.12	18.67	1 : 4.7
7	31.30	3.37	16.31	1.31	20.99	1 : 5.7
8	20.38	1.79	11.98	.80	14.57	1 : 7.7
9	26.52	2.53	15.74	.90	19.17	1 : 7.0
10	20.05	2.31	11.00	.72	14.03	1 : 5.4
11	26.58	2.21	12.31	1.30	15.82	1 : 6.9
12	24.23	1.86	14.03	.75	16.64	1 : 8.4
13	22.37	1.54	14.15	.72	16.41	1 :10.2
14	31.00	3.01	16.02	.87	19.90	1 : 6.0
15	23.79	2.73	12.46	.99	16.18	1 : 5.4
16	22.96	2.08	12.17	.71	14.96	1 : 6.6

WEIGHT OF CONCENTRATED FEEDING STUFFS.
(ALVORD.)

	Half Bushel Weighs	One Quart Weighs			
	Pounds.	Pounds,	Ounces	=	Pounds.
Wheat, whole	30	1	14	=	1.88
Cracked corn	28	1	12	=	1.75
Gluten meal	26	1	8	=	1.50
Cotton-seed meal	25½	1	9	=	1.56
Corn meal	23½	1	7	=	1.43
Corn and cob meal	22	1	6	=	1.38
Wheat middlings	18	1	2	=	1.13
Oats, whole	16	1	0	=	1.00
Ground oats	12		12	=	.75
Wheat bran	10		10	=	.63

FOOD REQUIREMENTS OF FARM ANIMALS.

It is generally assumed in comparing the food requirements of the different classes of farm animals that one cow at pasture will eat as much, or seven-tenths as much, daily as a full-grown horse, or as much as two yearling colts, heifers, or young bulls, or as three to five calves, or four colts taken from the mare, or ten to twelve sheep, or as twelve to twenty three-months-old lambs, or as four to five swine. It may be figured that the quantity of pasture grass eaten by a cow per day, which of course will vary with the season and the condition of the pasture, will equal 25–30 lbs. of good meadow hay or 40 lbs. hay of inferior quality.

COMPARATIVE VALUE OF CATTLE FOODS.

Comparing concentrated foods with coarse feeds, one pound of the former may be considered a *food unit*; the quantity of grass eaten by one cow at pasture during one day is assumed equivalent to 12 to 13 food units during the early part of the summer, and to 4 food units in the late fall, 10 units being considered an average figure.

The following quantities of different feeding stuffs are considered approximately equivalent, as determined by European, largely Danish, feeding experience (Schroll):

1 lb. concentrated feed (cereals, mill-refuse feeds, oil meals, etc.) = 2½ to 3 lbs. of good meadow hay = 4 lbs. of poorer quality hay = 10 lbs. rutabagas = 12½ lbs. turnips = 4 lbs. potatoes = 10 lbs. green fodder = 6 lbs. buttermilk = 6 lbs. skim-milk = 12 lbs. whey = 1 lb. new milk.

COMPARATIVE VALUE OF CATTLE FOODS.

(Hæcker.)

The following table is based upon the percentages of digestible protein in different feed stuffs, comparison of cost being made with wheat bran as a basis for grain, and timothy hay for coarse fodders. The figures given show only approximately the comparative value of the different food stuffs, as the digestible protein content, and not the total digestible matter of each food was considered in calculating the values. Since, however, protein is the most important component of foods bought, carbohydrates being, as a rule, produced in abundant quantities in the crops raised on the farm, the data obtained by this method of calculation may serve as a guide in estimating the comparative money value of cattle foods offered for sale.

Feed Stuffs.	Value per Ton or Bushel when Wheat Bran is worth				
	$9.00	$10.00	$12.00	$16.00	$20.00
Barley	$0.16	$0.18	$0.22	$0.30	$0.36
Indian corn	0.18	0.21	0.24	0.32	0.42
Corn and cob meal	0.16	0.18	0.22	0.30	0.36
Millet seed	0.20	0.22	0.26	0.34	0.44
Oats	0.10	0.12	0.14	0.18	0.24
Peas	0.40	0.47	0.56	0.74	0.94
Rye	0.22	0.24	0.28	0.38	0.48
Wheat shorts	7.20	8.00	9.60	12.80	16.00
Wheat	0.24	0.25	0.30	0.40	0.50
Cotton-seed meal	23.14	25.60	30.72	40.96	51.20
Linseed meal	19.86	22.08	26.50	35.32	44.16

Feed Stuffs.	Value per Ton when Timothy is worth			
	$4.50	$6.00	$8.00	$10.00
Clover hay, red	$10.06	$13.41	$17.88	$22.33
Corn stover	2.65	3.53	4.70	6.88
Fodder corn	3.44	4.59	6.12	7.65
Prairie hay (upland)	4.63	6.17	8.23	10.29
Prairie hay (mixed)	4.50	6.00	8.00	10.00
Sedge grass	4.50	6.00	8.00	10.00

PRICES OF CEREALS PER BUSHEL AND PER TON.

Name.	Weight per Bushel.	Factor.	Price per Bushel.	Price per Ton (2000 lbs.).	Name.	Weight per Bushel.	Factor.	Price per Bushel.	Price per Ton (2000 lbs.).
	lbs.		$	$		lbs.		$	$
Wheat.	60	33.3	.40	13.33	Oats... ...	32	62.5	.18	11.25
			.45	15.00				.20	12.50
			.50	16.67				.25	15.63
			.60	20.00				.30	18.75
			.75	25.00				.35	21.90
			1.00	33.33				.50	31.25
Corn...	56	35.7	.30	10.71	Rye	56	35.7	.40	14.28
			.35	12.50				.50	17.85
			.40	14.28	Barley......	48	41.7	.40	16.68
			.45	16.06				.50	20.83
			.50	17.85				.60	25.02

VALUATION OF FEEDING STUFFS.

The commercial value of protein, fat, and carbohydrates in concentrated feeding stuffs has been calculated from the average composition and market price of common feeding stuffs as follows:

	Cost of one pound of— Protein.	Fat.	Carbohydrates.	
In Germany... (1890)	3:	2:	1	(König, Wolff.)
" Connecticut (1888)	1.6 cts.	4.2 cts.	.96 cts.	(Jenkins.)
" " (1890)	1.4	2.9	1.4	"
" Wisconsin.. (1891)	1.5	3.6	.5	(Woll.)
" Indiana.... (1891)	1.0	2.75	.63	(Huston.)
" Minnesota.. (1893)	3.1	3.1	.24	(Hays.)

II. FARM ANIMALS.

CHARACTERISTICS OF BREEDS OF LIVE STOCK.

By Prof. J. A. Craig, of the Wisconsin Agricultural Experiment Station.

I. Light Horses.

The Thoroughbred.—Leading characteristics: running speed (Salvator, 1:35½, holds the world's mile record), quality, stamina, and ambition. Common colors: brown, bay, chestnut. Distinctive features: refined appearance, lengthy neck, deep chest, long body, straight croup, long thighs and pasterns, dense bone, firm muscle, active temperament, rangy type standing 16 hands. Most common defects: light bodies, lengthy pasterns, long legs, irritable temperament. Bred principally for racing, which has given them endurance and spirit. They are suited for mating with mares weighing 11 to 12 cwt., with the object of producing strong drivers or stylish carriage and saddle horses.

The American Trotter.—Chief characteristics: speed at the trotting gait. World's record for one mile against time is that of Alix, 2:03¾. The type of the leading campaigners is that towards which the trotter is tending; it is that of a horse required to have the endurance, ambition, and conformation to maintain trotting speed. Most general features: intelligent heads, light necks, low deep chests, oblique shoulders, long forearm, short cannons, round body rising slightly over loin, long croup and thighs, low hocks. Most common defects: undersize, deficiency in style, finish, and substance. Sphere: coach or carriage horses, roadsters, and trotters.

Cleveland Bay. — Uniform in color, being bay with black points. They stand at least 16 hands and are horses of larger size and more power than those of most other breeds of light horses. Rough joints, coarse bone, and deficiency in action are their most common defects. Their size, power, and evenness of disposition adapt them for general work on light farms, but owing to the defects mentioned they are not as popular for breeding road and carriage horses as those of other breeds.

French Coach.—Smooth, symmetrical, and generally of fine quality; very graceful in movement, with high knee-action and good back-action. Heads intelligent looking; necks graceful, bodies snugly ribbed, and quarters muscular. As a rule, they are striking in appearance, being upstanding and high-headed. Common colors: bay, brown, and black. Best suited for breeding coach-horses with moderately fast and graceful action. Defects: coarseness and lack of prepotency in the stallions due to their mixed breeding.

Hackney. — The typical hackney is a horse of extreme smoothness, with gracefully curved outlines. The head is light, neck muscular and curved, but free from heaviness; shoulders smooth and laid well back; body circular, compact, short; hips smooth; quarters plump with muscle; legs short, with tendons clearly defined. Their action is noted for its gracefulness and stylishness, being very high in the forelegs, and the hock movement is regular. Common colors: bay and brown. They are usually about 15.3 hands. Best suited for production of high-stepping cab and coach horses for city driving.

II. Heavy Horses.

Clydesdale.—Usual colors: bay, brown, black, or chestnut with white markings. The head is intelligent in features, but sometimes out of proportion with the other parts. Shoulder exceptionally good; being sloping, it gives them a free, easy, and long stride in the walk or trot; arm well-muscled, and legs clean and flat, with the fine and long feather springing from the edge; pasterns sloping, easing the feet from concussion;

feet large and durable. The croup is muscular and the quarters especially heavily-muscled. Their combination of weight, quality, and action is exceptional in draught-horses.

Shire.—The best type is low, broad, and stout. They are heavily built, muscular, with heavy bone and slow movement. The shoulder is usually too upright, making the action too short and stilted. The body is of large girth, deep and strongly coupled, with broad, short back and heavily-muscled quarters. Deficiencies: lack of quality, sluggish temperament, and limited action. In general they are heavier than the Clydesdale, though there is little difference between representative animals. The best type is suitable for breeding the heaviest class of draught-horses adapted to slow work demanding strength and heavy weight.

Percheron. — Types: the original gray in color, and the modern of black color. Most peculiar characteristics of the former were their action, style, endurance, and strength. They had intelligent heads, prominent chests, round bodies, large bone, inclined to roundness. The modern type is shorter-legged, more compact and stouter, but lacking the size of the original. The Percheron's excellencies are seen in their active temperament, intelligent heads, crested neck, deep body, and wide croup. Their deficiencies appear in defective legs, being light or round, straight pasterns, feet narrow at the hoof, heads and quarters lacking muscle. Best type adapted for breeding energetic, quick-gaited, strong horses suited for draught work of light nature.

Suffolk.—Color uniform, being some shade of chestnut. They are low-set, short-legged, deep-bodied, muscular horses, with clean bone and durable feet; docile, easy keepers, and steady when working. General deficiency: a lack of weight due to their smaller size in comparison with other draught-horses. Suited for general farm labor; they are not the highest-priced horses on the market owing to the demand for heavier weights.

III. Beef Cattle.*

Short-horns.—The three family types are: Bates, Booth, and Cruikshank. *Bates*, noted for style, fine heads, clean necks, straight level backs, light bone, and combination of milk and beefing qualities. *Booths* are especially excellent in girth, wide backs, lengthy quarters, deep flesh, and beefing qualities, though lacking in finish and style. *Cruikshanks*, noted for scale; low, broad, deep forms, heavy flesh, and mossy coats. The short-horn breed is specially noted for beef form, early maturity, and thrift under a variety of conditions. Their weakness in constitution and sterility is traceable to in-and-in breeding and artificial treatment. Their chief utility is to give beef form, quality, and rapid fattening tendencies to grades for stall feeding. Some families possess unequalled combination of beefing and milking qualities.

Aberdeen Angus. — Characteristic color, black. Head, hornless; neck free from loose skin, exceptionally good shoulder-vein; shoulder oblique, fitting close to body; ribs deep, very circular; hips moderately far apart, smoothly curved; rump long, level, smooth; thighs muscular, twist low and full, quarters long and rounded. Type: cylindrical, distinguished for smoothness, symmetry and quality; bone light, hide mellow, and coated with fine black hair. They are prepotent and prolific. Chief utility, production of beef of high quality.

Hereford.—Most popular color, dark claret or cherry, with white face, belly, switch, and small strip of white on neck and over shoulder. Type: low-set and broad; heavy in fore-quarters, with low heads; full, deep chest; hanging dewlap, level lack, wide thick loin, full quarters and thin thighs. Worst deficiencies, looseness in build and rough, coarse bone. They are strong-constitutioned, active rangers, prepotent and long-lived. Being active, hardy, and good feeders they make good grazing cattle, and on that account have been popular on ranches.

Galloway. — Color black, no white admissible, except on

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* For description of breeds of dairy cattle, see Part II, Dairying.

udder or below underline. Type: thick, close to ground, and symmetrical; hair long, wavy, and thick; head large, hornless, with no scurs; neck strong, giving a burly appearance to forequarters; shoulders snug, legs short and heavy, barrel round, tight-ribbed; quarter long and smooth; flesh even over all parts; hardiness and strength of constitution, strong features. Require more time to mature and yield larger percentage of offal than most other breeds. They are liked as ranch cattle, as they are hardy, hornless, and yield excellent beef and robes.

IV. Fine-wooled Sheep.

Merino.—The two types include those wrinkled and those smooth in body. They are chiefly noted for the heavy weights of fine wool that they shear. The fleece is dense, even, extending over all regions. The wool is bright, soft, fine, lustrous, and pure. They are hardy and strong in constitution, of a quiet disposition, and do well in large flocks.

V. Mutton Sheep.

Southdown.—Symmetrical, compact, close to the ground, and of fine quality; head medium size, hornless; forehead and face covered with wool, ears small, face brown or gray tint, neck short, breast broad, back and loin wide and straight, body deep, hips wide, twist full, fleece dense, and medium in length and fineness. The mutton is of high quality, and lambs mature early. They represent an exceptional combination of wool and mutton of fine quality.

Shropshire.—Face and legs dark brown in color. They are symmetrical and stylish. Rams are required to weigh 225 lbs. in full flesh, and ewes 175 lbs. Head short, covered with wool, hornless; neck well attached, full; body circular, round ribbed; quarters lengthy, inclined to narrowness and slackness. The fleece dense, fibre strong, about three and one half inches in length. The ewes are prolific and kind nurses. They combine quality and quantity of wool and mutton in a high degree, and are adapted to conditions of general farming and rolling land.

Hampshire.—Color of face dark brown or black; head large, nose prominent, neck regular, taper from head to shoulder;

strong-boned and lengthy. Especially noted for early development of lambs. They are vigorous and prepotent. The wool is short, dense, strong, and slightly coarse.

Suffolk.—Faces and legs deep black color. They are large sheep when mature ; lengthy and straight in form. Noted chiefly for prolificness and good milking and nursing qualities. A large percentage of lambs are reared in flocks of this breed; wool medium in quality and length.

Oxford.—Face either brown or gray, and lengthy. When mature they are the heaviest of the Down breeds, being larger in size and heavier in bone. Their fleece is also heavier and the fibre longer, coarser, and more open than most others. Squarer in form than the Shropshires, and not so closely covered with wool. Adapted to strong land; respond readily to high feeding.

Leicester.—Face bare and pure white, body square, straight, forequarters exceptionally full, hindquarters rounded slightly. Offal is light, bone fine, but fat too plentiful. The Border type is stronger boned, heavier, and more vigorous than the English. The Leicester has been extensively used for crossing on grades. Wool lustrous, five or six inches long, soft, but too frequently open and absent on the belly.

Cotswold.—Face white or slightly mixed with gray. Form large, square, upstanding, and stylish. A tuft of wool grows from forehead; fleece open, long, and heavily yielding. Body long, level, and wide. The gray-faced strain is considered hardier than the white-faced. The popularity of the breed lies in the large yield of wool and of mutton, though the quality of both is deficient.

Lincoln.—The largest of the long-wooled breeds. The wool is long and coarse, and especially lustrous. Square in form and, when mature, very heavy. The mutton lacks quality.

Cheviot.—Face bare, white, hornless; wool fine, and the fleece dense and even. Mutton agreeably flavored and fine-grained. They are hardy, active, prolific, and the lambs come active. They clip about four pounds of fine wool. Adapted to rough and high pasturage.

Dorset.—Face white ; rams and ewes horned. Type : long, round-bodied, and compactly built. Wool medium in length, fineness, and weight; average clip 6 pounds. Chief character-

istics: prolificness, hardiness, and breeding early, so as to drop lambs in winter.

Highland.—Rams and ewes horned, face and legs black and white. Low and blocky in type; fleece long, coarse. Their mutton has a superior flavor. Mountain breed hardy, active, and very strong of constitution.

VI. Swine.

Berkshire.—Color black, white on face, feet, tip of tail. Face short, dished; ears sharp-pointed, erect; jaws full, back broad, straight, full over shoulder; loin thick, level; hams exceptionally full, legs short, strong, and straight. Sows prolific, good nurses. Active and vigorous in temperament.

Poland-China.—Color dark, spotted, or black; head small, slightly dished; ears drooping, girth full, ribs well sprung, deep; hindquarters lengthy, though inclined to be drooping. They fatten readily, reach heavy weights, and are quiet-dispositioned.

Yorkshire.—White in color; separated into large, middle, and small varieties. The first-mentioned, are strong-boned, long-bodied, and deep-sided, and have mixed meat; middle or improved type, lighter in weight and bone, with smaller quantity of offal; small variety, quick in maturing and compact in form.

Chester-White.—White in color, strong-boned, vigorous, and attain to very heavy weights, though slow in maturing. Sows of good disposition and breeding qualities.

Duroc-Jerseys.—Deep, cherry red in color, large size, good breeders, and liked in Southern countries because of ability to withstand heat.

Victoria.—White in color with occasional black spots on skin; head small, face slightly dished; skin free from scurf; flesh of good quality and evenly laid over body. Yearling boars should weigh not less than 300 lbs.

Tamworth.—Red or dark brown color; snout very long, body narrow, exceptionally deep and long in sides. Their form and the mixture of fat and lean in their flesh make them a special bacon hog.

Essex.—Color black; type: small, compact, early maturing, and yielding a large percentage of edible meat.

FEEDING AND GENERAL CARE OF POULTRY.

By Prof. WM. P. WHEELER, of N. Y. (Geneva) Experiment Station.

Of the kinds of land birds and of water fowls under domestication the common "barnyard" fowls, of one general type, but of countless individual variations, and their thoroughbred varieties, are those usually thought of when the subject of poultry is mentioned, and these are the fowls of most general practical interest. It is remarkable that the common fowl, although so widely bred, and for so long, in Europe and America has no distinctive English name.

Ducks, turkeys, and geese constitute greater or smaller portions of the market poultry according to the particular locality and season, but the common fowl, besides producing most of the table poultry, is almost alone called upon for the egg supply.

The relative prices of eggs and market poultry, the proximity of markets, as well as the prices of foods, determine the relative profit in keeping larger or smaller breeds, even with eggs as the special object. The meat value of every fowl is of consideration sooner or later, and while the smaller hens will produce eggs cheaper, the greater net profit from hatching to market per hen may be with the larger breed.

Most of the thoroughbred varieties have their characteristics fairly established, so that it is better business policy to employ them rather than the uncertain mongrels, which, besides their unknown capabilities, are not less likely to suffer from long and careless inbreeding. The fancier who is fitted by judgment and experience to inbreed his stock closely will know how far he can go with safety; but one who finds it necessary to inquire about the advisability of inbreeding had better not attempt any.

Among the breeds that lay white-shelled eggs, Hamburgs, when of vigorous ancestry, probably are the most prolific. They certainly are exceptional layers, although the size of the egg is small. The Hamburg varieties possess in unusual degree the thoroughbred characteristics. Occasional complaints have been made in recent years concerning their stamina.

For egg production the Leghorns are typical fowls, and where white-shelled eggs are wanted the Leghorn varieties are more widely kept than any others.

The Minorcas, other members of the Mediterranean class, excel the Leghorns in size of eggs, but do not equal them in number.

Some strains and varieties of Pit Games are not far from the Leghorn in prolificacy.

Of the French breeds the Houdan is most widely bred in this country, and for such an excellent table fowl, is an exceptional layer of large white eggs.

The Polish, often wonderful layers, have sometimes suffered in vigor because of their beauty, which admirers hesitate to risk marring by introduction of distant blood.

Of the Asiatics, which lay brown-shelled eggs, the Langshan is high in favor with practical poultrymen. The Brahma, the largest of the thoroughbreds, also ranks high and lays large eggs. Those strains, however, bred for early laying are usually much inferior in size to the standard birds. The Cochin varieties are more particularly the pride of the fancier than of the farmer.

Of the American breeds the Plymonth Rock is undoubtedly the most popular. Its type of plumage possesses an unusual strength, even in blood much diluted, and faint reflections of the blue barring are seen in very distant relatives of the thoroughbred. The perfect markings of the showroom bird are, however, quickly lost. The American breeds lay brown-shelled eggs. Different flocks vary as much as the breeds or varieties in productiveness.

Many other breeds and varieties recognized by the American Poultry Association are of considerable economic value, but are less commonly kept.

In feeding most farm animals the usual purpose is only to secure meat, wool, milk, or work, and not always is consideration necessarily given to the breeding condition and the breeding season. When poultry is kept for other than fancy purposes, the life of the individual fowl is so short that there is not only an annual necessity of growing young birds with several more or less complete sets of

plumage, but egg production virtually implies a continual breeding condition, for the ultimate constituents of the egg are, with the exception of the amount obtained from the air, all that are combined in the living chick.

The body of a Leghorn pullet, about nine months old, in active laying, contains about 55.4 per cent of water, 21.2 per cent of different nitrogenous constituents, 18.0 per cent of fat, 3.0 per cent of ash or mineral matter, and 2.0 per cent of other substances, including also a little water lost in manipulation. Leghorn hens almost two years old and laying, showed an average composition of 55.7 per cent water, 21.6 per cent nitrogenous matter, 17.0 per cent of fat, 3.8 per cent ash constituents, and 1.7 per cent other substances. The body of a mature capon is composed of about 41.6 per cent of water, 19.4 per cent nitrogenous matter, 33.9 per cent fat, 3.7 per cent ash, and 1.4 per cent other substances.

Notwithstanding the fact that the problem of poultry feeding is much more complex than that of feeding most other farm stock, fewer carefully collected data are available in formulating feeding standards for poultry than for cattle. The following rations for laying hens are, however, near the average of those that have given best results. They are stated at the rate per 1000 lbs. live weight, to compare with the standards which have been used in feeding other animals.

One thousand pounds live weight of laying hens, of about three pounds average weight, require from 65 to 70 pounds of total food, less bulky than that for the cow, or about 52 pounds water-free food, per day, containing about 9 pounds digestible protein, 20 pounds digestible nitrogen-free extract and fiber, and 4 pounds of fat. From this ration the hens would produce generally from 16 to 31 pounds of eggs containing from 5.2 lbs. to 9.8 lbs. dry matter, one pound of eggs being produced from about 3.4 lbs. water-free food, one pound of dry matter of eggs for each 8.8 lbs. water-free food.

For one thousand pounds live weight of hens of about six pounds average weight, there should be fed from 40 to

50 lbs. of food per day, containing about 34 pounds of water-free food. There should be in this about 6 pounds of digestible protein, 14 pounds of digestible nitrogen-free extract and fiber, and 2 pounds of digestible fat.

Per hen the amount of food required per day varies according to the size and somewhat with the season. A smaller hen will eat more in proportion to live weight than a larger one. The difference in amount of food consumed by larger and smaller hens is less when laying than at other times, when enough for maintenance only need be eaten.

A Cochin or Brahma hen when laying requires about 4¼ ounces of food per day, of which 3¼ ounces is water-free food. A hen of Leghorn size when laying requires about 3½ ounces of total food, or 2¾ ounces of water-free food, per day.

A much larger amount of food in proportion to the live weight is required by the chicks than by the older fowls. The amount of water-free food required for every one hundred pounds live weight fed is 10.6 lbs. at about one pound average weight; at two pounds 7.5 lbs.; at three pounds 6.4 lbs; at four pounds 5.5 lbs.; at five pounds 5.3 lbs.; at six pounds 4.9 lbs.; at seven pounds 4.7 lbs.; at eight pounds 4 lbs.; at nine pounds 3.3 lbs.; at ten pounds average live weight 3.2 lbs. The amounts of fresh food equivalent to these weights would be correspondingly greater. These are the amounts taken by growing fowls which normally attain to the higher weights given, and which are still immature and growing rapidly when at five and six pounds average weight.

For young chicks the nutritive ratio of the ration fed can be somewhat narrower than those given for laying hens, and for fattening the ration can have a very much wider ratio, although only for short periods.

For one hundred hens about 16 quarts of clean water per day is required, especially in dry hot weather. In each dozen eggs there is about a pint of water.

A Variety of Food is Essential.

Young hens, especially of the better laying breeds, when in full laying, can be freely fed all they will readily eat, but

older hens and the young ones when not laying should be fed only enough to keep them eager for food.

Salt should be fed mixed with the food, but not large coarse crystals. One ounce of salt per day for one hundred hens is a good proportion.

Animal food and green or succulent vegetable food, as well as grain, should always be fed to hens that are confined.

Some form of grit should be liberally supplied.

A largely grain ration will not contain the lime required by laying hens, and oyster-shells or some other form of carbonate of lime will supply this deficiency.

A grass run is better than any substitute in summer, and enough hens to kill the grass should never be kept in a run.

Common fowls, especially laying hens, must be kept in moderately small flocks. Where large numbers are kept, they should be divided in small lots in separate pens and yards. Ten to twenty in a pen give better results than larger numbers. The laying hens should be kept separated from those not laying.

Hens will not always moult early enough to resume laying before midwinter. Chicks should be hatched in March and April if eggs are to be obtained from the pullets in November. Asiatics, to begin laying in the fall, should be hatched in February and March.

The best results in egg production cannot be secured where the average space of open run available per hen is much less than 100 square feet. The average floor-space per hen indoors should be about 20 square feet.

Exercise is of the utmost importance, especially for laying and breeding stock, and a good way to assure this in winter-time is to scatter the grain in straw or any clean and dry substitute.

Dampness is fatal, and dry warm houses free from draughts are essential in winter. The floors should be of dry earth or fine gravel, or wooden floors covered with straw or dry sand. The houses should be warm enough to prevent freezing of water, but should not be warmed by heating apparatus more than will insure against freezing.

SYNOPSIS OF BREEDS OF POULTRY.

(M. LEMOINE.)

Breeds.	Eggs Laid per Annum.	Weight per Dozen Eggs.	Live Weight of Hens.	Weight of Meat at 6 Months.		Weight of Bones and Offal.		Food Consumed Daily.
		oz.	lbs.	lb.	oz.	lb.	oz.	oz.
Andalusian	150	29¼	5– 6	3	1	2	15	6¾
Brahma (light)	120	28½	8–10	4	11	5	0	9½
Cochin (buff)	115	24	8–10	4	9	5	4¾	17½
Creve Cœur	122	33	8– 9	4	9⅛	4	14¼	7⅛
Dorking (silver gray)	130	27½	7–10	5	4½	4	14	6¾
" (dark)	130	27½	6– 9	5	4	3	12	6½
Game	100	24	5– 6	3	15½	2	7¾	4½
Hamburgs (silver spangled)	239	20¼	4– 5	2	3½	2	7¾	4¼
" (golden pencilled)	225	19½	3½–4	1	15¾	2	7½	4¼
Houdan	125	26	6– 7	3	7	2	10¼	6¾
La Flêche	140	29½	6– 7	3	5¾	2	9¾	6¾
Langshan	115	27	7–10	4	14¾	5	1¼	7⅛
Leghorn (brown)	190	22	5– 6	3	15½	2	10¼	4¾
Minorca (black)	180	28½	5½–7					
Plymouth Rock	120	27½	6– 7½					
Scotch Gray	140	29	6	3	4½	2	12	6¾
Wyandottes	140	25	5½–7					

HEREDITY.

By Prof. THOS. SHAW, of Minnesota Experiment Station.

Heredity in breeding relates to transmission. It is doubtless governed by fixed laws, but many of these are as yet imperfectly understood. It may be defined as the outcome of the operation of that law whereby properties and qualities of like kind with those of the parents are transmitted to the offspring. This transmission is certainly comprehensive in its character, since it relates to structure, function and qualities, and indeed to every feature of the organization. But in instances not a few there are apparent exceptions to this law of transmission. These, however, are apparent rather than real. They appear to us as exceptions because of the limitations of our knowledge of this great question. These supposed exceptions are doubtless the result of the predominant influence of other laws acting in opposition to the hereditary tendency, and it is characterized as normal, abnormal, and acquired, according to its nature.

The heredity of normal characters means the transmission of those characters which are natural to the type. These may be original traits bestowed upon the species, as for instance, timidity in sheep; or they may have been acquired and rendered permanent by long-continued transmission, as in the changed form of all the improved breeds of domestic animals. The heredity of abnormal characters means the transmission of irregular characters, or those which have deviated from the natural and acquired characteristics of the type. These abnormal characters may appear as malformations of structure, derangement of function, or they may assume one or the other of various forms of disease. Illustrations of the first are found in certain families with an irregular number of fingers and toes; of the second in the inheritance of deafness, dumbness and impaired vision; and of the third, in the reappearance in the offspring of certain diseases possessed by the parents, as, for instance, any of the forms of scrofula.

The laws which govern heredity are those also which determine the results in practical breeding. In practice the rules which govern it are almost entirely empirical in their origin, since they have been almost exclusively derived from the accepted methods of the most successful breeders. Those who have given thought to the question will concede that breeding live-stock is at once a science and an art. They will see in it a *science* in so far as it discovers and systematically arranges those truths and principles which relate to the improvement of live-stock, and it will appear to them an *art* in so far as they perceive that those principles can be successfully utilized in practice. It is apparent therefore that the relation between the science and the art of breeding is both close and intimate. Without some knowlege of the former the latter is not likely to be successfully practised, and the measure of success which attends the efforts of the breeder will be largely proportionate to the measure of the knowledge which he may possess of the principles of heredity.

Reference has been made to certain laws which govern transmission. Of these three may be considered as funda-

mental, viz.: *first*, the law that "like begets like"; *second*, the law or principle of variation; and *third*, the law or principle known as atavism. Since these laws or principles appear to us to lack uniformity and regularity of action, the art of breeding is in consequence much more complicated and uncertain than it would otherwise be. This want of uniformity and of regularity of action, however, is apparent rather than real. But so long as we are ignorant of the cause or causes of these apparent irregularities in transmission, we are unable to prevent them. And yet there is so much of uniformity in the action of these laws that the intelligent breeder cannot be said to play at a game of chance. If well posted in the art, his efforts will in the main be entirely successful.

The law that "*like begets like*" implies that the characteristics of the parents will appear in their offspring. This law would seem to pervade all animated nature; generally speaking it is uniform in its action, but there are some exceptions. Were it not so, examples to illustrate such a law of heredity and proofs to support it would not have been needed. That the existence of this law was recognized, and that many of its principles were well understood from an early period, finds ample illustration in the breeding operations conducted by the patriarch Jacob, in the monstrous forms that were bred for the amusement of the Romans when the decline of the empire was pending, and in the care with which the Arabs kept their pedigrees from a remote antiquity.

So uniform is this principle of heredity in its action that it may be designated the compass which guides the breeder into the harbor of success. But before he can anchor there he must give attention to certain principles, a close adherence to which is absolutely essential to higher attainment in results. He must, for instance, breed to a standard of excellence; he must set a proper value on improved blood; and he must understand the art of selection and the principles of good management generally. Without a standard of excellence in his mind, that is, without an ideal type, the breeder does not himself know what he is seeking.

Without dominant or stable characters, in at least one parent, no stability in transmission can be looked for, and without purity of breeding for generations dominant characters cannot be secured. Hence the great importance of purity of blood in effecting improvement in domestic animals. Since some inferior animals will occasionally appear, even where the breeding is the most skilful, the necessity will always exist for the exercise of a most rigorous selection on the part of every breeder who is to stand on the upland of success. When aided by judicious selection, the law that like produces like enables us to effect improvement until a certain standard of excellence is reached, to maintain improvement when it has been secured, and to mould new types and form new breeds.

By the *law* or *principle of variation* is meant the tendency sometimes found in animals to produce characters in the progeny which differ from those of the parental type. These changes relate to both form and function; in time they may become modifications of the systems of animals. They may be classed as *gradual*, or *general* and *ordinary;* and as *sudden*, or *spontaneous* and *extraordinary*. *General variation* is that tendency to change from the original type which characterizes in a greater or a less degree all the individuals of a breed. Illustrations of the principle of general variation may be found, *first*, in the tendency of grain to deteriorate which has fallen upon an unkindly soil ; and *second*, in the quick deterioration of the heavy breeds of sheep when confined to unproductive and rugged pastures. Chief among the numerous causes leading to general variation are changed conditions of life in animals, as climate, food, habit, and environment. Sometimes these influences act independently and sometimes in conjunction. The principle of *spontaneous variation* may be defined as that tendency sometimes found in animals to produce progeny more or less unlike either of the parents or the ancestry of these. Illustrations of the operation of this principle may be found in the occasional production of progeny very unlike the parents or the ancestry in color, form, and other characteristics, and in the existence of hornless breeds of cattle.

By *atavism* is meant that innate tendency in animals to revert to the original type. It differs from the principle that like produces like in the reproduction of resemblances to an ancestry more or less remote rather than to the parents, and differs from spontaneous variation in producing resemblances to an ancestry more remote than the immediate parents, whereas the latter produces characters unlike those of the ancestry, whether near or remote. Illustrations of atavic transmission are found in the occasional apearance of scars or horns in the polled breeds of cattle bred pure for many successive generations, and in the occasional appearance of tan-colored spots on the ears and face of the American merino.

It is evident, therefore, that an intimate knowledge of the principles which govern breeding is highly important to those engaged in the production of live-stock. Hence they should study these with the utmost care and should embody them in their practice to the greatest possible extent.

III. VETERINARY SCIENCE.

COMMON DISEASES OF FARM ANIMALS.

By W. G. Clark, M.D.C., Beaver Dam, Wis.

I. HORSES.

The common method of administering medicine to the horse is in the form of a drench. In drenching a horse the bottle should be clean, strong, and smooth. The head should be elevated just enough to prevent the horse from throwing the liquid from the mouth. If the animal refuses to swallow, tickle the roof of the mouth with the finger or the neck of the bottle. Do not rub, pinch, or pound the throat, nor draw the tongue out. These in no way aid the horse to swallow and often do harm. If coughing occurs or by any mishap the bottle is crushed in the mouth, lower the head at once. Do not attempt to pour medicine through the nose; it is liable to strangle the animal.

Irritating substances, as turpentine, should be given in bland fluids such as oil or milk.

Warm-water injections are of great value in treating many bowel troubles. A very good injection pipe may be made with about 30 inches of inch rubber hose and an ordinary tin funnel. Oil the hose and insert it in the rectum from 12 to 18 inches, and elevate the funnel above the back and pour in the water. The force of gravitation will carry it into the bowels.

Soap and water, or salt and water, may be injected in this manner in quantitities of a gallon or more every hour.

Spasmodic Colic.

Causes.—Error in diet is the most prolific cause, as improper food in improper quantities at irregular intervals; large draughts of cold water when warm; eating when exhausted; intestinal parasites; or foreign bodies in the bowels.

Symptoms.—The horse manifests uneasiness, moves forward and back in the stall, looks toward the flank, switches the tail, paws, lies down and rolls; after a little the spasm will subside and the animal become quiet. Soon the spasm returns with

increased severity. As the disease progresses, the animal will become more violent and the intervals between the spasms shorter.

TREATMENT.—Always urgent, as it often runs a rapid course, terminating fatally in a few hours.

Give as a drench laudanum 1 oz., baking-soda one tablespoonful, sweet spts. nitre 1 oz., water one half-pint. This may be repeated in half an hour if not relieved. Always give injections of soap and warm water. Blanket the animal and rub the abdomen briskly. If inclined to hang on, apply a paste of mustard to the abdomen and give raw linseed oil 1 pt., chloral hydrate 4 dr., dissolved in warm water.

Flatulent Colic.

The causes and symptoms are similar to those of spasmodic colic.

The pain is not so severe at the outset and gradually increases in severity as the bowels become distended by gas. No intervals of ease as in spasmodic colic. The abdomen becomes rapidly distended and the animal dies from suffocation or rupture of the bowels unless soon relieved.

TREATMENT.—Usually necessary to puncture with a trocar and canula, which requires a knowledge of the anatomy of the parts. Internally give hyposulfite of soda 2 oz., fl. ex. ginger 4 dr., spts. turpentine 4 dr., water 1 pint. Repeat in half an hour if necessary. Give injection of soap and warm water at short intervals.

Pneumonia—Lung Fever.

The most common cause is exposure to a cold draught when tired and sweaty.

SYMPTOMS.—It is usually ushered in with a chill, followed by fever. The ears and legs are cold, pulse-rate increased, labored breathing, elbows turned out, increased working of the ribs, the animal persistently stands, appetite usually lost.

TREATMENT.—Place in a comfortable well-ventilated box-stall. Blanket warmly, rub the legs and apply bandages.

During the chill give large doses of stimulants, as whisky, alcohol, ginger, etc., at short intervals.

If the breathing is not relieved in a few hours, apply mustard over the ribs, just back of the shoulder-blades.

Give nourishing, easily digested food. Keep the animal perfectly quiet. Give 1-oz. doses of nitrate of potash in the drinking-water three times daily. After the chill is relieved keep a pail of fresh water before the animal at all times.

Azoturia—Black-water.

This disease is quite common among farm horses, and is due solely to overfeeding on nitrogenous foods and lack of exercise, followed by the accumulation in the system of waste matters.

SYMPTOMS.—The animal is taken from the barn after a few days' rest on full rations, apparently as well as usual. After driving from half a mile to six or eight miles the horse will begin to lag and sweat profusely. Shortly will begin to go lame, usually in one hind limb. If urged on, will soon lose the use of the limbs and fall to the ground, unable to rise. The urine if passed will be dark and coffee-colored. This is a diagnostic symptom. The muscles over the hips become hard and swollen, and the animal will struggle convulsively and attempt to rise.

TREATMENT.—Unhitch the animal as soon as the first symptoms are noticed and take the horse to the nearest barn. Fold a woolen blanket and wring out of hot water and place over the hips, covering with a dry blanket. Repeat as soon as it becomes cool, and continue this until the more acute symptoms are relieved. Internally give laudanum 1 oz., raw linseed oil one pint, and repeat the laudanum in an hour if the pain is not relieved. If possible, the urine should be drawn with a catheter, as it is rarely passed when the animal is down. Give injections of soapy warm water at frequent intervals.

Distemper—Strangles.

This is a contagious disease due to a specific virus that very few horses escape. It usually runs a benign course and terminates favorably.

Treatment.—It is not of much use to attempt to check the course of the disease; in all cases proper shelter and nursing are most important.

Give laxative sloppy food and apply warm poultices to the throat, to hasten suppuration. In no case give purging or depressing medicines. In fact, the whole treatment consists in producing and favoring the discharge of the abscess. As soon as fluctuation can be detected the abscess should be opened. When the disease assumes the malignant form or is complicated, apply to a competent veterinarian.

Sprains.

Treatment.—Rest in a quiet well-bedded stall. If the injury is below the knee or hock and the weather is warm, bathe the part three times daily for an hour at a time with cold water and rub dry.

If above the knee or hock, or the weather is cold, use hot water.

After bathing apply a mild stimulant, as spirits of camphor, arnica, etc.

If the lameness persists after the active inflammation is reduced use the following liniment: aqua ammonia and spirits turpentine, 4 oz.; of each linseed oil 8 oz.; mix and apply twice daily with friction.

Punctured Wounds of the Foot.

In all cases the horn around the seat of the injury should be thinned down and a free opening made for the escape of the products of suppuration. Cauterize the wound with 95 per cent carbolic acid and apply a poultice. Change twice daily and dress the wound with the following lotion: Zinc sulph. 1 oz., sugar lead 1 oz., carbolic acid 4 dr., water 1 pint.

Thrush.

The most common cause of thrush is the filthy condition of the stable in which the horse is kept. Muddy yards and roads, also hard work on rough, stony roads may excite this disease.

Symptoms.—Increased secretion in the cleft of the frog and an offensive odor. After a time considerable discharge takes place and there is rapid destruction of the tissue of the frog.

Treatment.—Remove the cause. Cut away all diseased tissue and cleanse the foot thoroughly. Take white vitriol 1 oz., and water 6 ozs. Saturate pledgets of tow or cotton with the solution and crowd into the cleft and each side of the frog. Dress once daily until the discharge ceases.

Cuts from Barb-wire, etc.

When bleeding to any extent follows a wound, this must first be checked.

A moderately tight bandage with oakum, tow, or cobwebs will usually stop the bleeding in a short time. If the blood is bright red and flows in jets,apply a compress between the wound and the heart.

If it is dark and the flow regular, apply pressure between the wound and the extremity. Cleanse the wound thoroughly with warm water and a soft sponge. Then dress with a 3 per cent solution of carbolic acid and apply a bandage so as to bring the edges together. If proud flesh appears, treat it with burnt alum.

II. COWS.

Milk Fever.

SYMPTOMS. — Dulness, uneasy movements of the hind limbs, head and horns hot; the animal soon becomes weak and unable to rise, head laid back on the flank or dashed to the ground, bowels constipated, sensation usually lost.

TREATMENT.—Give a purgative dose of salts. Apply mustard paste along the spine. Blanket and keep warm.

Give injections of soap and warm water. Internally give ½ pt. of whisky, fl. ex. belladonna ½ oz., tr. nux vomica 2 dr. every three hours.

PREVENTION.—Spare diet a week before and after calving. If constipated after delivery give a dose of salts.

Garget.

CAUSES.—Irregularities of diet, overfeeding on stimulating food, exposure to cold, external injuries, as blows, etc.

SYMPTOMS.—Seldom attacks the whole udder. Swelling, heat, pain, and redness of the inflamed portion. The milk is curdled, whey-like, and mixed with blood. In severe cases there is much constitutional disturbance.

TREATMENT.—Endeavor to discover the cause and remove it. The food should be devoid of milk-producing constituents. Draw the milk frequently, using a milking-tube if necessary.

If the weather is warm bathe the udder for an hour or more with hot water.

Take fluid extract belladonna 1 oz., glycerin 2 ozs.;

mix and apply three times daily with mild friction. Give two teaspoonfuls fluid extract belladonna three times daily. If constipated, give epsom salts 1 lb., ginger 1 oz., water 1 qt.

Abortion.

The cow may abort from any cause profoundly disturbing the nervous system, inflammation of the internal organs, diarrhœa, acute indigestion, blows on the abdomen, exposure to cold storms, drinking ice-water, feeding on ergotized grains and grasses, and infection from abortion discharges of other animals.

Symptoms.—If it occurs within the first two months it is not apt to be noticed. During the latter part of gestation abortion resembles normal delivery, except that more effort and straining are present.

Treatment.—The most important object in an impending abortion is to recognize it as soon as possible and apply preventive measures. Place in a quiet dark stall and check straining by sedatives. Laudanum 1 oz.; repeat in two hours if necessary; or fl. ex. black haw. in same doses.

After an abortion burn the fœtus and afterbirth and all litter that is soiled, or bury deeply and cover with quicklime.

Flood the womb with a 2% solution of carbolic acid and wash the external organs once daily with a 5% solution. Separate from the herd for 30 days.

In epizootic abortion material benefit has in many cases been derived from phosphate of lime. Small doses (½ dram) may be given daily in the food.

Hoven or Bloat.

Causes.—Overeating, choking, frosted roots, and fermentation of the food.

Treatment.—In urgent cases tap on the left side at a point equidistant from the point of the hip, the last rib and the processes of the lumbar vertebræ, pointing the trocar or knife downward, inward, and forward. If slight give

spts. turpentine 1 oz., raw linseed oil ½ pt., and place a gag in the mouth.

When relieved give a purgative and keep on a light diet for a few days.

Diarrhœa in Calves.

Always due to indigestion and caused usually by over-feeding or improper food.

PREVENTION.—Feed at least three times daily. The milk should be sweet and fed at a temperature of 90° to 100° F. The pails used in feeding should be kept sweet and clean.

TREATMENT.—Cut down the ration, scald the milk or add lime-water in the proportion of 1 to 5. If the discharges are bright yellow give castor oil 1 to 2 tablespoonfuls. If there is great weakness give small doses of stimulants (ginger, brandy, whisky).

Choking.

Common among cattle when fed on roots, etc. To prevent tie the head so that it cannot be thrown up, or withhold dangerous foods.

SYMPTOMS.—Head extended, bloating, labored breathing, continuous coughing. If in the throat there is great distress and the animal may die quickly. If lower the symptoms are not as acute.

TREATMENT.—If in the throat remove with the hand. If below reach and the object can be located from the outside, give small drenches of linseed oil and manipulate from the outside. Take time. Do not apply too much force. Usually best to work the object toward the throat.

If unable to remove the object it must be pushed down; this may be done with a piece of 1-in. rubber-hose, 6 ft. in length, well oiled, and inserted in the gullet, and gently force the object down.

Tuberculosis.

Tuberculosis is an infectious disease characterized by the formation in the various organs of the body of tubercles or

nodules, and is due to a specific micro-organism, the *bacillus tuberculosis.*

Tuberculosis in animals is identical with tuberculosis (consumption) in the human family, the ravages of which are far greater than those of any other disease.

The death rate from consumption, which is but one of its many forms, is about one in seven.

All domestic animals are more or less subject to the disease. Dairy cattle, however, in consequence of their mode of life and the heavy drain on their system from excessive breeding and milking, are more predisposed to the disease than any other of the domestic animals.

CAUSE.—The essential cause is the specific germ, the tubercle bacillus, without which the disease could not exist. Since the disease is found in the lungs in a large proportion of cases, it is evident that tuberculosis is usually contracted by inhaling the germs with the air. It may also be caused by the ingestion of infected meat and milk and by direct inoculation.

The development of the disease is favored by anything that tends to impair the general health of the animal, as overcrowding in poorly ventilated stables, hereditary predisposition, in-and-in breeding, lack of exercise, errors in diet, etc.

SYMPTOMS.—The symptoms are very obscure, and in some cases where the disease is well advanced there is seemingly little alteration in the health of the animal. The most prominent symptoms are a short, husky cough, enlargement of the lymph glands around the throat, dulness, capricious appetite, staring coat, and emaciation.

Persistent œstrum or heat, with barrenness, especially when there is a harsh, staring coat and general unthrifty condition, is suspicious.

THE TUBERCULIN TEST.—Tuberculin is a glycerin extract of the soluble products produced by the growth of the tubercle bacillus, concentrated, filtered, and sterilized. When properly prepared it contains no living germs and cannot produce tuberculosis. It was introduced to the medical profession by Dr. Koch as a cure for tuberculosis.

Although it has not found practical application as a curative agent, it furnishes us the best diagnostic agent for bovine tuberculosis yet known.

A summary of statistics indicates that about 88 per cent of tuberculous animals show the reaction fever on inoculation, while 90 per cent that were declared free from disease on account of the absence of fever did not show on autopsy any signs of the disease.

PREVENTION.—The stables should be light and well ventilated. Cattle should be kept from interchange of stalls or stanchions. Breed only from healthy animals. No consumptive person should be allowed to care for stock.

Isolate all suspected animals. Such animals should be examined by a competent veterinarian, and if found to be tuberculous the whole herd should be tested. Tuberculous animals should be killed and the carcasses burned or buried deeply and covered with quicklime. Disinfection should be thorough. Remove and burn all litter. Burn sulphur in the closed stable. Wash or spray all woodwork with a solution of corrosive sublimate, one part, to one thousand parts of water.

Corrosive sublimate is a deadly poison and should be used with care. Whitewash with freshly slaked lime.

III. SHEEP.

Scab.

Due to parasitic mites which infest the skin.

SYMPTOMS.—Intense itching, small reddish pimples appear, rupture, and discharge a watery fluid; scabs form, the wool falls out in patches. Large sores sometimes result from the incessant rubbing. The parasite may be seen with a low-power lens.

TREATMENT.—Take one pound of tobacco to each five gallons of water and boil until the strength is exhausted from the leaves. Strain and add one pound of sulphur to each five gallons. Allow each sheep to remain in the bath for five minutes, working the solution into all parts of the skin and breaking up the scabs. Place on a slooping rack and press the liquid out of the fleece, allowing it to run back into the trough. The same dip may be used for ticks.

Foot-Rot.

Separate the sound animals from the diseased ones and from contaminated pastures and buildings. Carefully remove all diseased horn and foreign bodies and walk the sheep through a trough containing one pound of blue vitriol to three gallons of water. Place the infected flock on a dry upland pasture, if possible.

Grub in the Head.

This is the larvæ of a small gadfly (*vestrus ovis*) which deposits its eggs within the nostrils. It stays there during the winter and spring, often proving harmless, but sometimes causing much irritation, a white muco-purulent discharge, with dullness and stupor.

PREVENTION.—Smear the nose with tar, or feed salt from two-inch augur-holes bored in a log, the surface of which is smeared with tar.

TREATMENT.—Place in a warm building and introduce into the nostrils snuff, a solution of tobacco, or turpentine and olive-oil equal parts, to kill the larvæ or cause their expulsion by sneezing; or place in a close room and subject to the fumes of burning sulphur for 15 min., as strong as can be endured, once daily for 3 or 4 days.

IV. SWINE.

Hog Cholera.

A specific contagious fever of swine.

SYMPTOMS.—The period of incubation varies from three to fifteen days. Shivering, nose hot and dry, later refuses food, lies under the litter, eyes sunken, gait unsteady. Heat and soreness of the skin, with tenderness, red patches and black spots; labored breathing; hard, dry cough; soreness of the belly; costiveness, followed by a fœtid diarrhoea.

PREVENTION.—If it breaks out in a herd, kill and bury the diseased. Thoroughly disinfect everything they have come in contact with, using one-half ounce of corrosive sublimate in four gallons of water. Burn all straw and litter. Give the healthy ones clean, dry quarters. If possible, divide up the herd, placing a few in each pen. Allow free access to

wood or animal charcoal and give in the drinking-water ten drops of carbolic acid for each one hundred and fifty pounds of live weight. Take the temperature daily, inserting a clinical thermometer in the rectum, and remove every animal showing a temperature of 103° or over.

Kill and bury as soon as the symptoms of the disease are well manifested.

Medicinal treatment of the disease is of but little avail. A good dietetical treatment, including a strict observance of sanitary principles, is of much more importance than the use of medicines.

The pens should be kept scrupulously clean. The food given should be clean, of the best quality, and easily digested. The troughs used in feeding should be thoroughly cleaned at least once daily. Keep away from infected herds, as the germs may be carried on the shoes or clothing. It is said that the virus will blow half a mile on the wind. It may also be spread by birds and dogs.

Intestinal Worms.

This is one of the most common troubles of swine.

Symptoms.—A cough is usually the first symptom noticed; animals have a voracious appetite, yet lose flesh and exhibit general signs of ill health. If the fæces are examined the worms or their eggs can usually be found.

Treatment.—Give one teaspoonful of spirits of turpentine for each one hundred and fifty pounds of live weight once daily in milk or oil. Place common salt where they can have free access to it. Give nutritious, easily digested food.

VETERINARY REMEDIES AND DOSES.

By W. G. Clark, M. D. C., Beaver Dam, Wis.

Graduation of Doses.

Horse.	Ox.	Dose.
3 years.	2 years.	1 part.
2 "	1 "	2/3 "
1 "	9 months.	1/3 "
6 months.	3–6 "	1/8 "
1–6 "	1–3 "	1/16—1/32 part.

When not specified, the doses given apply to a full-grown horse of medium size. Dose for the ox, from 1½ to 2 parts; sheep, ⅛ to ¼ part. Animals of a nervous temperament are usually more susceptible to the action of drugs.

No agent should be given until sufficiently diluted to prevent irritation of the mouth, and irritants that will not mix with water (turpentine, etc.) should be given in linseed oil, milk, or eggs, after being thoroughly mixed.

Raw Linseed Oil.—Dose: Horse, one half-pint to one quart. Laxative in small doses, purgative in large. Not so active as castor oil. A valuable laxative in young and delicate animals. For calves and lambs it is more gentle and safer than salts. In adults it is the best laxative to use where there is an irritable condition of the bowels, and in all febrile diseases where a laxative is needed. In impaction of the bowels a pint may be given two or three times daily until relieved, supplemented by warm-water injections every two hours. Valuable in cases of choking on account of its lubricating qualities.

Castor Oil.—Causes more griping and nausea than linseed oil and is more certain in its action. Used chiefly as a laxative for calves, foals, sheep, swine, and dogs.

Useful in diarrhœa of calves and other young animals when the discharges are bright yellow and irritating. Dose for a calf, from 1 to 4 tablespoonfuls.

Epsom Salts.—For cattle this is the purgative in most frequent and general use. Adult cattle take from 1 lb. to 1½ lbs. In small doses in febrile diseases it lowers the temperature, improves the appetite, and helps to maintain a healthy and regular action of the bowels. Epsom salts is one of the best antidotes for lead poisoning. When used as a purgative, give from 1 to 2 oz. ginger with the salts.

Oil of Turpentine (Spts. Turpentine).—Dose: Horse, ½ to 1 oz. Very irritating to the mucous membrane, and when used internally should be given in oil or some bland fluid. Stimulant and anti-spasmodic. One of the most useful remedies in flatulent colic in the horse, and hoven or bloat in the ox. Also used to kill and expel intestinal worms. When used for this purpose, it is given after fasting in

large doses, 1½ to 2 oz. for the horse, followed in 12 hours by a purgative.

Applied externally it is an irritant and is used in many liniments. The following liniment may be used where a mild counter-irritant is desired: Oil of turpentine and aqua ammonia, of each 4 oz., linseed oil 8 oz. Mix. This liniment is used chiefly for rheumatic swellings, sprains, and bruises after the active pain is subdued by fomentations, and for sore throats, as seen in distemper.

ALCOHOL.—Dose: Horse, ½ oz. well diluted, whisky or brandy 2 to 4 oz. Alcohol is a narcotic poison. It first stimulates, then deranges, and ultimately depresses the functions of the brain and spinal cord. It kills, as a rule, by paralysis of respiration. Medicinally it is a very valuable, diffusible stimulant, anti-spasmodic heart tonic and antiseptic. Moderate doses increase the gastric secretions and aid digestion, but large doses destroy pepsin, arrest secretion, and interfere with absorption. There is probably no drug more extensively used than alcohol. It is useful in indigestion, spasmodic colic, cases of poisoning by aconite or tobacco. It is valuable in influenza and debilitating diseases. In blood-poisoning whisky combined with quinine is one of the most effective agents we have in controlling the temperature and keeping up the strength of the animal.

The following is very useful in some cases of indigestion: Whisky 1 pt., quinine (sulfate) 1 oz., water 1 pt. Mix. Give 3 ounces at intervals of 3 to 4 or 6 hours, according to the nature of the case.

SALTPETER (NITRATE OF POTASH).—Dose: Horse, 1 teaspoonful to half an ounce. Large doses are irritant and cathartic and are liable to cause inflammation of the bowels. Medicinal doses are discretive, alterative, antiseptic, febrifugal, and refrigerant. In febrile, inflammatory, and rheumatic complaints it allays fever, lowers excessive temperature, and removes by the kidneys both solid and fluid matters. Dissolved in water and applied externally it abstracts heat and is a useful refrigerant. Combined with sulfate of iron it makes an excellent tonic for horses recovering from debilitating diseases.

Saltpeter 2 oz., dried sulf. iron 3 oz. Mix. Give 2 teaspoonfuls with the feed 2 or 3 times daily.

ALUM.—Alum is an astringent. Chiefly used externally. Use a saturated solution in hot water. Applied to the shoulders of horses in the spring it toughens the skin and prevents collar-galls. Useful in healing harness-galls. One of the best lotions to apply to barb-wire cuts and other wounds of a similar nature to prevent growth of proud flesh. Sometimes dusted over the surface in the form of burnt alum; not so effective as the saturated solution.

GINGER.—Dose: Horse, ½ to 1 oz. Ginger stimulates the various mucous membranes with which it comes in contact. Administered internally it increases the gastric secretions, facilitates digestion, and checks formation of gas. It is a useful adjunct to many medicines and is given with tonics and stimulants. Combined with purgatives it diminishes their liability to nauseate and gripe, and also hastens their effect. It is used in all domesticated animals to fulfil those purposes, and is especially adapted to cattle and sheep.

CARBOLIC ACID.—One of the best and cheapest disinfectants known. For dressing fresh wounds it may be used in from 2 per cent to 5 per cent watery solution. In oil 1 part to 15. Inhalation of the vapor with steam is of great service in malignant sore throat and abscesses following strangles. Carbolic acid is a narcotic irritant poison, and considerable care must be exercised in its use, as it is liable to become absorbed and produce poisonous effects if applied over a large surface in a strong solution. It has been highly recommended in the treatment of hog cholera. It may be given to hogs in doses of from 1 to 5 drops well diluted.

PINE TAR.—Not much employed internally. It is a good dressing in thrush and canker of the horse's foot. It is also of special service in foot-rot in sheep. It acts as a stimulant and deodorizer to foul-smelling wounds and prevents the attacks of flies.

LIME WATER.—Lime water is prepared by slaking a small quantity of freshly burned lime with a large quantity of

water, allowing the undissolved matter to settle and pouring off the clear solution. This should be kept in tightly corked bottles. Lime water is an alkali and is used in indigestion, bloat, and diarrhœa, especially among calves. Given with the milk in the proportion of 1:5. Scalds and burns may be treated with carron oil, which is composed of lime water and linseed oil, equal parts. Fresh lime in powder and solution is used in cleansing and disinfecting stables. For this purpose a little carbolic acid may be added to the solution.

SULFUR.—In large doses it is an active irritant poison. In medicinal doses it is a laxative, alterative, and stimulates secretion. Care should be taken to prevent the animal from taking cold when given sulfur. It opens the pores of the skin and stimulates perspiration. Chiefly used in treating rheumatism and chronic skin diseases. Dose: Horse, ½ oz. to 2 oz.

SUPPRESSION OF HOG CHOLERA AND SWINE PLAGUE. (CRAIG.)

CAUSES.—Hog cholera and swine plague are caused by different bacteria, but they are equally dependent for the success of their attacks on the unhealthiness of the hogs, due in most instances to unwholesome food and filthy surroundings. The causes are so similar and the symptoms are so much alike and often complicated that it will be best to consider the diseases together in what follows. The germs that cause them are easily spread over large territories by being carried by cars, wagons, or the shoes of persons that have been among infected hogs. Most frequently the origin of the outbreak may be traced to the importation of hogs from diseased districts or to spread from such centers by running streams.

SYMPTOMS.—The first symptoms usually shown in attacks of these diseases are those that indicate fever—a rise in temperature, thirst, loss of appetite, and redness of the skin on the lower part of the neck and inner side of the thigh. Usually a hog so diseased begins to cough when started

from its bed. A constipated condition of the bowels changes to diarrhœa as the disease progresses, and this results in a rapid loss of flesh. Dissection generally shows the lungs to be inflamed, the spleen enlarged, or the lining of the large intestine covered with numerous ulcers.

PREVENTION.—To protect hogs from attacks of these diseases it is necessary to observe the following recommendations: The hogs should not be watered at running streams, as the germs are readily carried by these. Persons coming from infected districts should not be allowed to go near your hogs, and you should not go among your neighbors' hogs if they are sick. When other hogs are brought to your farm, assume that they are infected and keep them away from yours at least for six weeks. Observe as much cleanliness as possible in regard to food and surroundings. Feed a mixture of foods in a sloppy or soft condition, and withhold heavy grain feeding. Disinfect the quarters of the hogs by sprinkling liberally with a five per cent solution (by volume) of carbolic acid, and use a two per cent solution of the same for washing the hogs.

TREATMENT.—The hogs showing any of the symptoms described should at once be separated from the others, and put in cheaply constructed quarters, so that the latter may be burned when no longer required. The well hogs should be removed to disinfected quarters. Give all the hogs the following mixture, recommended by Dr. Salmon, Chief of the Bureau of Animal Industry:

Wood charcoal	1 lb.
Sulfur	1 "
Salt	2 lbs.
Baking-soda	2 "
Glauber's salts	1 lb.
Sodium hyposulfite	2 lbs.
Antimony sulfid	1 lb.

This should be given in soft food in the proportion of a teaspoonful daily to a two hundred pound hog. Remove all refuse from the pens in which the infected hogs were kept, and dig out the old soil, put in fresh earth, disinfect

with carbolic acid solution, and allow the pens to remain vacant for at least six months. The same feeder should not attend the well and the sick hogs unless his shoes are changed after each visit to the sick hogs. The bodies of the dead hogs should be thrown into a rubbish heap and burned; but if this cannot be easily carried out, a long, deep trench should be dug, and when the carcases are thrown into it they should be covered with a layer of quicklime and at least six inches of earth. When the disease has spent itself or has been effaced, the entire mass in the trench should be covered with six inches of quicklime and at least six feet of earth. The place selected for the burial of the hogs should not drain towards a stream, and it would be better to fence it. The dead hogs should never be drawn over the ground, and the wagon used should be washed with a disinfectant.

REMEDIES FOR THE HORN FLY.

(WEED.)

The most satisfactory way of preventing the attacks of the horn fly is to apply to the cattle some substance that serves as a repellent; the best results are obtained by the use of a cheap oil, such as fish oil or crude cotton-seed oil, to which a small amount of carbolic acid or pine tar has been added. Either of the following formulas are recommended for this purpose:

1. Crude cotton-seed oil, or fish oil, 3 parts. Pine tar, 1 part.

2. Crude cotton-seed oil, or fish oil, 100 parts. Crude carbolic acid, 3 parts.

In either case these substances are to be mixed, and applied rather lightly to the cattle by means of a wide paint brush, a sponge, or even a woolen cloth; the combination immediately drives off the flies, and remains on in condition to keep them off for about five days. A combination of kerosene emulsion and tobacco decoction may also be used with good effect.

LIST OF DISINFECTANTS.

(STERNBERG.)

The most useful agents for the destruction of spore-containing infectious material are:

1. *Fire.*—Complete destruction by burning.
2. *Steam under Pressure*, 105° C. (221° F.,) for ten minutes.
3. *Boiling in Water* for half an hour.
4. *Chlorid of Lime* (should contain at least 25 per cent of available chlorin).—A 4 per cent solution.
5. *Mercuric Chlorid.*—A solution of 1–500.

For the destruction of infectious material which owes its infecting power to the presence of micro-organisms not containing spores, any of the following agents are recommended:

1. *Fire.*—Complete destruction by burning.
2. *Boiling in water* for ten minutes.
3. *Dry Heat*, 110° C. (230° F.), for two hours.
4. *Chlorid of Lime.*—A 2 per cent solution.
5. *Solution of Chlorinated Soda* (should contain at least 3 per cent of available chlorin).—A 10 per cent solution.
6. *Mercuric Chlorid.*—A solution of 1–2000.
7. *Carbolic Acid.*—A 5 per cent solution.
8. *Sulfate of Copper.*—A 5 per cent solution.
9. *Chlorid of Zinc.*—A 10 per cent solution.
10. *Sulfur Dioxid* (this will require the combustion of between 3 and 4 lbs. of sulfur for every 1000 cubic feet of air-space).—Exposure for twelve hours to an atmosphere containing at least 4 volumes per cent of this gas, *in presence of moisture.*

RULES FOR DISINFECTION OF STABLES.

In Case of Appearance of Contagious Diseases.

(TRUMBOWER.)

1. Have all loose litter, hay, and rubbish removed and burned.
2. Have all manure removed to land where cattle have no access.
3. Have all feed-troughs, hay-racks and all woodwork

thoroughly cleaned by washing with hot water in which two ounces of carbolic acid to each gallon of water are dissolved.

4. Thoroughly whitewash the whole of the interior of the building with a whitewash containing one pound of chloride of lime to each four gallons of water. Enough freshly burned quicklime should be added to make the wash show where applied. Especially should this be applied to the sides and front of the stalls, feed-troughs and hay-racks (inside and outside).

5. All rotten woodwork to be removed and burned, and replaced with new.

6. All buckets, forks, shovels, brooms, and other objects used about the stable to be washed and covered with the same solution.

7. All drains to be thoroughly cleaned and disinfected with a solution of chloride of lime, one pound to four gallons of water.

8. In cases of glanders, all harness, poles, and shafts of wagons, neck-yokes and pole-straps should be thoroughly washed with hot water and soap, and afterwards oiled with carbolized oil (one part of carbolic acid to ten of oil). Before applying the oil, harness should be hung up in the open air for one week.

REGULATIONS FOR THE GOVERNMENT OF Dairies and Dairy Farms in the District of Columbia.

SECTION 1.—No building shall be used for stabling cows for dairy purposes which is not well lighted, ventilated, drained, and constructed.

SEC. 2.—No building shall be used for stabling cows for dairy purposes which is not provided with a suitable floor, laid with proper grades and channels to immediately carry off all drainage; and if a public sewer abuts the premises upon which such building is situated, they shall be connected therewith whenever, in the opinion of the health officer, such sewer connection is necessary.

SEC. 3.—No building shall be used for stabling cows for dairy purposes which is not provided with good and suffi-

cient feeding-troughs or boxes, and with a covered water-tight receptacle, outside of the building, for the reception of dung and other refuse.

SEC. 4.—No water closet, privy, cesspool, urinal, inhabited room, or workshop shall be located within any building or shed used for stabling cows for dairy purposes, or for the storage of milk or cream, nor shall any fowl, hog, horse, sheep, or goat be kept in any room used for such purposes.

SEC. 5.—The space in buildings or sheds used for stabling cows shall not be less than five hundred cubic feet for each cow, and the stalls therefor shall not be less than four feet in width.

SEC. 6.—It shall be the duty of each person using any premises for keeping cows for dairy purposes to keep such premises thoroughly clean and in good repair and well painted or whitewashed at all times.

SEC. 7.—It shall be the duty of each person using any premises for keeping cows for dairy purposes to cause the building in which cows are kept to be thoroughly cleaned, and remove all dung from the premises so as to prevent its accumulation in great quantities.

SEC. 8.—It shall be the duty of any person having charge or control of any premises upon which cows are kept to notify the health officer, in writing, of the existence of any contagious or infectious disease among such cows, within twenty-four hours of the discovery thereof, and to thoroughly isolate any cow or cows affected or which may reasonably be believed to be infected, and to exercise such other precautions as may be directed, in writing, by the health officer.

SEC. 9.—Any person using any premises for keeping cows for dairy purposes shall provide and use a sufficient number of receptacles made of non-absorbent materials, for the reception, storage, and delivery of milk, and shall cause them at all times to be cleansed and purified, and shall cause all milk to be removed without delay from the rooms in which the cows are kept.

SEC. 10.—Every person keeping cows for the production

of milk for sale shall cause every such cow to be cleaned every day and to be properly fed and watered.

SEC. 11.—Every person using any premises for keeping cows shall cause the yard used in connection therewith to be provided with a proper receptacle for drinking water for such cows; none but fresh, clean water to be used in such receptacle.

SEC. 12.—Any enclosure in which cows are kept shall be graded and drained so as to keep the surface reasonably dry and to prevent the accumulation of water therein, except as may be permitted for the purpose of supplying drinking water; no garbage, urine, fecal matter, or similar substances shall be placed or allowed to remain in such enclosure, and no open drain shall be allowed to run through it.

SEC. 13.—These regulations shall apply to all premises upon which cow's milk is produced for sale.

SEC. 14.—That any person violating any of these regulations shall, on conviction in the police court of said district, be punished by a fine of not less than five nor more than ten dollars for each and every offense, to be collected as other fines and penalties are collected.

IV. FIELD CROPS.

QUANTITY OF SEED REQUIRED TO THE ACRE.

(WARING.)

Designation.	Quantity of Seed.	Designation.	Quantity of Seed.
Wheat	1¼ to 2 bu.	Broom-corn	1 to 1½ bu.
Barley	1½ to 2½ bu.	Potatoes	5 to 10 bu.
Oats	2 to 4 bu.	Timothy	12 to 24 qts.
Rye	1 to 2 bu.	Mustard	8 to 20 qts.
Buckwheat	¾ to 1⅓ bu.	Herd grass	12 to 16 qts.
Millet	1 to 1½ bu.	Flat turnip	2 to 3 lbs.
Corn	¼ to 1 bu.	Red clover	10 to 16 lbs.
Beans	1 to 2 bu.	White clover	3 to 4 lbs.
Peas	2½ to 3½ bu.	Blue grass	10 to 15 lbs.
Hemp	1 to 1½ bu.	Orchard grass	20 to 30 lbs.
Flax	½ to 2 bu.	Carrots	4 to 5 lbs.
Rice	2 to 2½ bu.	Parsnips	6 to 8 lbs.

When planted in rows or drills:

Broom-corn	1 to 1½ bu.	Onions	4 to 5 lbs.
Beans	1½ to 2 bu.	Carrots	2 to 2½ lbs.
Peas	1½ to 2 bu.	Parsnips	4 to 5 lbs.
		Beets	4 to 6 lbs.

SEED MIXTURES FOR HAY AND PERMANENT PASTURES

In Pounds per acre.

Names of Grasses.	I. Flint.	II. Lawson.	III. For Good Medium Soils. De Launé	IV. For Wet Soils. De Launé	V. For Chalky Soils. De Launé	VI. For Permanent Lawns. Flint.
Meadow foxtail......	2	2	10	4	....	3
Orchard grass........	6	4	....	....	....	3
Sweet-scented vernal	1	......	....	....	....	2
Meadow fescue.......	2	2	6	3	2	2
Tall fescue	......	2	3	8	....	2
Hard fescue.	......	2	1	1	4	2
Sheep's fescue.......	......	......	1	....	4	2
Redtop	2	2	....	....	....	3
June grass...........	......	2	....	....	....	4
Kentucky blue grass.	4	......	....	....	....	....
Italian rye grass......	4	6	....	....	....	3
Perennial rye grass..,	6	8	....	....	....	4
Timothy	3	3	3	3	....	3
Rough meadow grass	2	2	1½	2	....	3
Wood meadow grass.	......	2	....	....	....	....
Red clover...........	......	......	....	....	....	2
Perennial red clover.	3	2	1	1	1	2
White (Dutch) clover	5	5	1	1	1	2
Alsike.............. ..	......	......	1	1	1	....
Yellow oat grass.....	......	1	....	....	1	1
Cock's-foot....	......	......	7	10	14	....
Crested dog's-tail .:.	......	......	2	2	5	....
Fiorin....	......	......	1½	2	....	....
Yarrow...............	......	......	1	1	2	....
Cat's-tail	......	......	....	....	3	....
Cow grass....	......	......	1	1	....	....
	40	45	41	40	38	43

For the Northwest the following mixture will, according to Shaw, be found suitable:

Timothy 4 lbs., blue grass 3 lbs., redtop 2 lbs., orchard grass 2 lbs., meadow fescue 1 lb., tall oat grass 1 lb., meadow foxtail 1 lb., alsike clover 3 lbs., white clover 2 lbs., lucern (alfalfa) 2 lbs., yellow clover 1 lb., total 22 lbs.

And for the States east of Michigan and for the provinces of Canada eastward of Lake Huron:

Lucern (alfalfa) 5 lbs., orchard-grass 4 lbs., meadow fescue and alsike clover 3 lbs. each, tall oat grass, timothy, meadow foxtail, and white clover 2 lbs. each, yellow clover 1 lb.; total 24 lbs.

Henry recommends the following mixture of grass and clover seed (pounds per acre):

Timothy	7	pounds.
Orchard	4	"
Italian rye	2	"
Perennial rye	2	"
Tall oat	2	"
Redtop	2	"
Kentucky blue	2	"
Alfalfa	4	"
White clover	1	"
Alsike clover	1	"
Red clover	2	"
Total	29	"

Flint gives the following mixtures, among others, as representing the common ones adopted in New England and among farmers throughout the country:

1. ½ bu. (6 lbs.) redtop; 1 peck (11 lbs.) timothy; 5 lbs. red clover.
2. 1 bu. (12 lbs.) redtop; 1 peck (11 lbs.) timothy; 8 lbs. red clover.
3. 4 qts. (1½ lbs.) redtop; 1 peck (11 lbs.) timothy; 2 qts. red clover; 1 pint white clover.
4. 12 qts. (16½ lbs.) timothy; 4 lbs. clover.
5. 1 bu. redtop; ½ bu. timothy; 10 lbs. clover.
6. 1 peck redtop; 1 peck timothy; 10 lbs. clover, etc.

THE WEIGHT AND AVERAGE COMPOSITION OF ORDINARY CROPS IN POUNDS PER ACRE.

(WARINGTON.)

	Weight of Crop.		Total Pure Ash.	Nitrogen.	Sulfur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.	Chlorin.	Silica.
	At Harvest.	Dry.										
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Wheat:												
grain, 30 bu..	1,800	1,530	30	33	2.7	9.3	0.6	1.0	3.6	14.2	0.1	0.6
straw......	3,158	2,653	142	15	5.1	19.5	2.0	8.2	3.5	6.9	2.4	96.3
Total crop..	4,958	4,183	172	48	7.8	28.8	2.6	9.2	7.1	21.1	2.5	96.9
Barley:												
grain, 40 bu..	2,080	1,747	46	35	2.9	9.8	1.1	1.2	4.0	16.0	0.5	11.8
straw.......	2,447	2,080	111	13	3.2	25.9	3.9	8.0	2.9	4.7	3.6	56.8
Total crop..	4,527	3,827	157	48	6.1	35.7	5.0	9.2	6.9	20.7	4.1	68.6
Oats:												
grain, 45 bu..	1,890	1,625	51	38	3.2	9.1	0.8	1.8	3.6	13.0	0.5	19.9
straw.......	2,835	2,353	140	17	4.8	37.0	4.6	9.8	5.1	6.4	6.1	65.4
Total crop..	4,725	3,978	191	55	8.0	46.1	5.4	11.6	8.7	19.4	6.6	85.3
Maize:												
grain, 30 bu..	1,680	1,500	22	28	1.8	6.5	0.2	0.5	3.4	10.0	0.2	0.5
stalks, etc....	2,208	1,877	99	15	....	29.8	...	.. .	.	8.0		
Total crop..	3,888	3,377	121	43	....	36.3	...	....	....	18.0		
Meadow hay, 1½ tons.....	3,360	2,822	203	49	5.7	50.9	9.2	32.1	14.4	12.3	14.6	56.9
Red clover hay, 2 tons........	4,480	3,763	258	102	9.4	83.4	5.1	90.1	28.2	24.9	9.8	7.0
Beans:												
grain, 30 bu..	1,920	1,613	58	77	4.4	24.3	0.6	2.9	4.2	22.8	1.1	0.4
straw.......	2,240	1,848	99	29	4.9	42.8	1.7	26.3	5.7	6.3	4.3	6.9
Total crop..	4,160	3,461	157	106	9.3	67.1	2.3	29.2	9.9	29.1	5.4	7.3
Turnips:												
root, 17 tons.	38,080	3,126	218	63	15.2	108.6	17.0	25.5	5.7	22.4	10.9	2.6
leaf..........	11,424	1,531	146	49	5.7	40.2	7.5	48.5	3.8	10.7	11.2	5.1
Total crop..	49,504	4,657	364	192	20.9	148.8	24.0	74.0	9.5	33.1	22.1	7.7
Swedes:												
root, 14 tons..	31,360	3,349	163	70	14.6	63.3	22.8	19.7	6.8	16.9	6.8	3.1
leaf..........	4,704	706	75	28	3.2	16.4	9.2	22.7	2.4	4.8	8.3	3.6
Total crop..	36,064	4,055	238	98	17.8*	79.7	32.0	42.4	9.2	21.7	15.1	6.7

* Calculated from a single analysis only.

THE WEIGHT AND AVERAGE COMPOSITION OF ORDINARY CROPS.—*Continued.*

	Weight of Crop. At Harvest.	Weight of Crop. Dry.	Total Pure Ash.	Nitrogen.	Sulfur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.	Chlorin.	Silica.
Mangolds:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
root, 22 tons..	49,280	5,914	426	87	4.9	222.8	69.4	15.9	18.3	36.4	42.5	8.7
leaf.	18,233	1,654	254	51	9.1	77.9	49.3	27.0	24.2	16.5	40.6	9.2
Total crop..	67,513	7,568	680	138	14.0	300.7	187.7	42.9	42.5	52.9	83.1	17.9
Potato:												
tubers, 6 tons.	13,440	3,360	127	47	2.7	76.5	3.8	3.4	6.3	21.5	4.4	2.6
Beech:												
wood.........	......	2,822	26	10	....	4.2	0.8	12.9	3.4	1.5	....	2.2
leaf litter. ...	......	2,975	166	39	...	8.8	1.6	73.1	10.9	9.3	...	53.9
T'l produce.	......	5,797	192	49	....	13.0	2.4	86.0	14.3	10.8	....	56.1
Scotch pine:												
wood	......	2,884	15	....	....	2.3	0.2	9.0	1.5	1.0	....	0.5
leaf litter.....	......	2,845	42	...	...	4.3	1.7	16.8	4.3	3.3	...	5.8
T'l produce.	......	5,729	57	....	...	6.6	1.9	25.8	5.8	4.3	....	6.3
Spruce fir:												
wood	......	3,064	20	....	....	3.6	0.4	8.2	1.8	1.3	....	2.9
leaf litter.....	....	2,683	121	....	....	4.3	1.5	54.4	6.2	5.7	...	44.3
T'l produce.	......	5,747	141	....	.	7.9	1.9	62.6	8.0	7.0	....	47.2

SOILING CROPS ADAPTED TO NORTHERN NEW ENGLAND STATES. (LINDSEY.)

(For 10 cows' entire soiling.)

Kind.	Seed per Acre	Time of Seeding.	Area.	Time of Cutting
Rye	2 bush....	Sept. 10–15	½ acre	May 20—May 30
Wheat...........	"	"	"	June 1—June 15
Red clover	20 lbs.........	July 15—Aug. 1	"	June 15—June 25
Grass and clover..........	½ bu. redtop... 1 peck timothy. 10 lbs. red clover	Sept.	⅔ acre	June 15—June 30
Vetch and oats.	3 bush. oats.... 50 lbs. vetch ...	April 20	½ acre	June 25—July 10
" " "	" " ...	" 30	"	July 10—July 20
Peas and oats..	1½ bu. Canada. 1½ bu. oats ...	" 20	"	June 25—July 10
" " "	" "	" 30	"	July 10—July 20
Barnyard millet..	1 peck	May 10	⅓ acre	July 25—Aug. 10
" " ..	"	" 25	"	Aug. 10—Aug. 20
Soja bean (medium green)....	18 quarts.......	" 20	"	Aug. 25—Sept. 15
Corn	....	" 20	"	Aug. 25—Sept. 10
"	....	" 30	"	Sept. 10—Sept. 20
Hungarian......	1 bush...	July 15	½ acre	Sept. 20—Sept. 30
Barley and peas	1½ bu. peas.... 1½ bu. barley..	Aug. 5	1 acre	Oct. 1—Oct. 20

TIME OF PLANTING AND FEEDING SOILING CROPS. (Phelps.)

Kind of Fodder.	Amount of Seed per Acre.	Approximate Time of Seeding.	Approximate Time of Feeding.
1. Rye fodder......	2½ to 3 bu.	Sept. 1	May 10–20
2. Wheat fodder..............	2½ to 3 bu.	Sept. 5–10	May 20, June 5
3. Clover..................	20 lbs.	July 20–30	June 5–15
4. Grass (from grass-lands)....			June 15–25
5. Oats and peas.....	2 bu. each	April 10	June 25, July 10
6. " " "	2 " "	" 20	July 10–20
7. " " "	2 " "	" 30	" 20, Aug. 1
8. Hungarian................	1½ bushels	June 1	Aug. 1–10
9. Clover rowen (from 3)......			" 10–20
10. Soja beans........	1 bushel	May 25	" 20, Sept. 5
11. Cow-peas...........	1 bushel	June 5–10	
12. Rowen grass (from grass-lands).			Sept. 5–20 " 20–30
13. Barley and peas............	2 bu. each	Aug. 5–10	Oct. 1–30

The dates given in the table apply to Central Connecticut and regions under approximately similar conditions.

CYLINDRICAL SILOS.

Approximate Capacity of Cylindrical Silos for Well Matured Corn Silage, in Tons. (King.)

Depth. Feet.	Inside Diameter in Feet.										
	15	16	17	18	19	20	21	22	23	24	25
20.....	58.84	66.95	75.58	84.74	94.41	104.6	115.3	126.6	138.3	150.6	163.4
21.....	62.90	71.56	80.79	90.57	100.9	111.8	123.3	135.3	147.9	161.0	174.7
22.....	67.35	76.52	86.38	96.84	107.9	119.6	131.8	144.7	158.1	172.2	186.8
23.....	71.73	81.61	92.14	103.3	115.1	127.5	140.6	154.3	168.7	183.6	199.3
24.....	76.12	86.61	97.78	109.6	122.1	135.3	149.2	163.7	179.0	194.9	211.5
25.....	80.62	89.64	103.6	116.1	129.3	143.3	158.0	173.4	189.5	206.4	223.9
26.....	85.45	97.23	109.8	123.0	137.1	151.9	167.5	183.8	200.9	218.8	237.4
27.....	90.17	102 6	115.8	129.8	144.7	160.3	176.7	194.0	212.0	230.8	250.5
28.....	94.99	108.1	122.0	136.8	152.4	168.9	186.2	204.3	223.3	243.2	263.9
29.....	99.92	113.7	128.3	143.9	160.3	177.6	195.8	214.9	234.9	255.8	277.6
30.....	105.0	119.4	134.8	151.1	168.4	186.6	205.7	225.8	246.8	268.7	291.6
31.....	109.8	124.9	141.1	158.2	176.2	195.2	215.3	236.3	258.2	281.8	305.1
32. ..	115.1	135.9	147.8	165.7	184.6	204.6	225.5	247.5	270.5	294.6	319.6

Area of Feeding Surface and Inside Diameter of Cylindrical Silo Required to Supply Herds of Different Sizes. (King.)

	Feeding Surface.	Inside Diameter.
30 cows	150 square feet	14 feet.
40 "	200 " "	16 "
50 "	250 " "	18 "
60 "	300 " "	19.75 "
70 "	350 " "	21.25 "
80 "	400 " "	22.75 "
90 "	450 " "	24 "
100 "	500 " "	25.25 "

NUMBER OF PLANTS FOR AN ACRE OF GROUND.

Distance apart. Inches.	Number of Plants.	Distance apart. Feet.	Number of Plants.
3 × 3	696,960	6 × 6	1210
4 × 4	392,040	6½ × 6½	1031
6 × 6	174,240	7 × 7	881
9 × 9	77,440	8 × 8	680
Feet.		9 × 9	537
1 × 1	43,560	10 × 10	435
1½ × 1½	19,360	11 × 11	360
2 × 1	21,780	12 × 12	302
2 × 2	10,890	13 × 13	257
2½ × 2½	6,960	14 × 14	222
3 × 1	14,520	15 × 15	193
3 × 2	7,260	16 × 16	170
3 × 3	4,840	16½ × 16½	160
3½ × 3½	3,555	17 × 17	150
4 × 1	10,890	18 × 18	134
4 × 2	5,445	19 × 19	120
4 × 3	3,630	20 × 20	108
4 × 4	2,722	25 × 25	69
4½ × 4½	2,151	30 × 30	48
5 × 1	8,711	33 × 33	40
5 × 2	4,356	40 × 40	27
5 × 3	2,904	50 × 50	17
5 × 4	2,178	60 × 60	12
5 × 5	1,742	66 × 66	10
5½ × 5½	1,417		

NUMBER OF HILLS OR PLANTS ON AN ACRE OF land, for any distance apart, from 10 in. to 6 ft., the lateral and longitudinal distances being unequal. (WARING.)

Distance.	10 in.	12 in.	15 in.	18 in.	20 in.	2 ft.	2½ ft.	3 ft.	3½ ft.	4 ft.	4½ ft.	5 ft.	5½ ft.	6 ft.
in.														
10	62726													
12	52272	43560												
15	41817	34848	27878											
18	34848	29040	23232	19360										
20	31363	26136	20908	17424	15681									
ft.														
2	26136	21780	17424	14520	13068	10890								
2½	20908	17424	13939	11616	10454	8712	6969							
3	17424	14520	11616	9680	8712	7260	5808	4840						
3½	14935	12446	9953	8297	7467	6223	4976	4148	3565					
4	13068	10890	8712	7260	6534	5445	4356	3630	3111	2722				
4½	11616	9680	7744	6453	5808	4840	3872	3226	2767	2420	2151			
5	10454	8712	6969	5808	5227	4356	3484	2904	2489	2178	1936	1742		
5½	9504	7920	6336	5280	4752	3960	3168	2640	2263	1980	1760	1584	1440	
6	8712	7260	5808	4840	4356	3630	2904	2420	2074	1865	1613	1452	1320	1210

V. HORTICULTURE.

USUAL DISTANCES FOR PLANTING VEGETABLES.

(BAILEY.)

Asparagus....	Rows 3 to 4 ft. apart, 1 to 2 ft. apart in row.
Beans, bush..	2 to 3 ft. apart, 1 ft. apart in rows.
" pole...	3 to 4 ft. each way.
Beet, early ...	In drills 12 to 18 in. apart.
" late......	" " 2 to 3 ft. "
Cabbage, early	16 × 28 in. to 18 × 30 in.
" late..	2 × 3 ft. to 2½ × 3½ ft.
Carrot........	In drills 1 to 2 ft. apart.
Cauliflower...	2 × 2 ft. to 2 × 3 ft.
Celery........	Rows 3 to 4 ft. apart, 6 to 9 in. in row.
Corn, sweet ..	" 3 to 3½ ft. apart, 9 in. to 2 ft. in row.
Cucumber	4 to 5 ft. each way.
Egg-plant.....	3 × 3 ft.
Lettuce.......	1 × 1½ or 2 ft.
Melon, Musk..	5 to 6 ft. each way.
" Water..	7 to 8 ft. each way.
Onion........	In drills from 14 to 20 in. apart.
Parsnip.......	" " 18 in. to 3 ft. apart.
Peas..........	" " early kinds, usually in double rows 6 to 9 in. apart; late, in single rows, 2 to 3 ft. apart.
Pepper.......	15 to 18 in. × 2 to 2½ ft.
Potato........	10 to 18 in. × 2½ to 3 ft.
Pumpkin.....	8 to 10 ft. each way.
Radish.......	In drills, 10 to 18 in. apart.
Rhubarb......	2 to 4 ft. × 4 ft.
Salsify	In drills, 1½ to 2 ft. apart.
Spinach	" " , 12 to 18 in. apart.
Squash.......	3 to 4 ft. × 4 ft.
Sweet-potato..	2 ft. × 3 to 4 ft.
Tomato.......	4 ft. × 4 to 5 ft.
Turnip........	In drills, 1½ to 2½ ft. apart.

QUANTITY OF SEED OF VEGETABLES REQUIRED TO SOW AN ACRE. (Bailey.)

Asparagus	4 or 5 lbs., or 1 oz. for 50 ft. of drill.
Beans, dwarf, in drills	$1\frac{1}{2}$ bushels.
" pole "	10 to 12 quarts.
Beet, "	5 to 6 lbs.
Buckwheat, "	1 bushel.
Cabbage, in beds to transplant	$\frac{1}{4}$ lb.
Carrot, in drills	3 to 4 lbs.
Cauliflower	1 oz. of seed for 1000 plants.
Celery	1 oz. of seed for 2000 plants.
Corn, in hills	8 to 10 quarts.
Cucumber, in hills	2 lbs.
Cress, water, in drills	2 to 3 lbs.
" upland, in drills	2 to 3 lbs.
Egg-plant	1 oz. of seed for 1000 plants.
Kale or sprouts	3 to 4 lbs.
Lettuce	1 oz. of seed for 1000 plants.
Melon, musk, in hills	2 to 3 lbs.
" water, in hills	4 to 5 lbs.
Mustard, broadcast	$\frac{1}{2}$ bushel.
Onion, in drills	5 to 6 lbs.
" seed for sets, in drills	30 lbs.
" sets, in drills	6 to 12 bushels.
Parsnip, in drills	4 to 6 lbs.
Peas "	1 to 2 bushels.
Potato (cut tubers)	7 bushels.
Pumpkin, in hills	4 to 5 lbs.
Radish, in drills	8 to 10 lbs.
Sage "	8 to 10 lbs.
Salsify "	8 to 10 lbs.
Spinach "	10 to 12 lbs.
Squash, bush, in hills	4 to 6 lbs.
" running, in hills	3 to 4 lbs.
Tomato, to transplant	$\frac{1}{4}$ lb.
Turnip, in drills	1 to 2 lbs.
" broadcast	3 to 4 lbs.
Grass (mixed lawn)	2 to 4 bushels.

DISTANCES APART FOR FRUIT TREES,

Time Required to Bear Fruit, and Longevity. (BAILEY.)

	Usual Distances.	Time Required to Bear.	Average Profitable Longevity under high Culture.
Apples........	30 to 40 ft. each way.	3 yrs. Good crop in about 10 years......	25–40 yrs.
" dwarf...	10 ft. each way.......	....	....
Blackberry.....	4×7 to 6×8 ft...	1 yr. Good crop in 2–3 years	8–12 yrs.
Currant........	4×5 feet.............	1 yr. Good crop in 2–3 years...	20 years.
Gooseberry.....	4×5 feet.............	1 yr. Good crop in 2–3 years....... ...	20 years.
Orange and lemon ..	25 to 30 ft. each way.	2–3 yrs. Good crop 2–3 years later.......	50 or more.
Peach..........	16 to 20 ft. each way.	2 yrs. Good crop in 4 years..............	8–12 yrs.
Pears...........	20 to 30 ft. each way.	3 or 4 yrs. Fair crop in 6–12 years.......	50–75 yrs.
Persimmon.....	20 to 25 ft. each way.	1 to 3 yrs.....	25–40 yrs.
Plum	16 to 20 ft. each way.	3 yrs. Good crop in 5 to 6 years.........	20–25 yrs.
Raspberry . ..	3×6 feet	1 yr. Good crop in 2 or 3 years..	8–12 yrs.
Strawberry ...	1×3 or 4 feet...	1 yr. Heaviest crop usually in 2 years...	3 years.

AVERAGE YIELDS PER ACRE OF VARIOUS CROPS. (BAILEY.)

Apples	A tree 20 to 30 years old may be expected to yield from 25 to 40 bus. every alternate year.
Artichoke	200 to 300 bus.
Beans, green or snap	75 to 120 bus.
Bean, Lima	75 to 100 bus. of dry beans.
Beet	400 to 700 bus.
Carrots	400 to 700 bus.
Corn	50 to 75 bus., shelled.
Cranberry	100 to 300 bus.; 900 bus. have been reported.
Cucumber	About 150,000 fruits per acre.
Currant	100 bus.
Egg-plant	1 or 2 large fruits to the plant for the large sorts like New York purple, and from 3 to 8 fruits for the smaller varieties.
Gooseberry	100 bus.
Grape	3 to 5 tons. Good raisin vineyards in California, 15 years old, will produce from 10 to 12 tons.
Horse-radish	3 to 5 tons.
Kohlrabi	500 to 1000 bus.
Onion, from seed	300 to 800 bus.; 600 bus. is a large average yield.
Parsnip	500 to 800 bus.
Pea, green, in pod	100 to 150 bus.
Peach	In full bearing a peach-tree should produce from 5 to 10 bus.
Pear	A tree 20 to 25 years old should give from 25 to 45 bus.
Pepper	30,000 to 50,000 fruits.
Plum	5 to 8 bus. may be considered an average crop for an average tree.
Potato	100 to 300 bus.
Quince	200 to 400 bus.
Raspberry and blackberry	50 to 100 bus.
Salsify	200 to 300 bus.
Spinach	200 barrels.
Strawberry	75 to 250 or even 300 bus.
Tomato	8 to 16 tons.
Turnip	600 to 1000 bus.

RELATION OF SPECIFIC GRAVITY,
Dry Matter, and Starch Content of Potatoes.
(WOLFF.)

Spec. Grav.	Dry Substance.	Starch Content.	Spec. Grav.	Dry Substance.	Starch Content.	Spec. Grav.	Dry Substance.	Starch Content.
	Per ct.	Per ct.		Per ct.	Per ct.		Per ct.	Per ct.
1.080	19.7	13.9	1.107	25.5	19.7	1.134	31.3	25.5
.081	19.9	14.1	.108	25.7	19.9	.135	31.5	25.7
.082	20.1	14.3	.109	25.9	20.1	.136	31.7	25.9
.083	20.3	14.5	1.110	26.1	20.3	.137	31.9	26.1
.084	20.5	14.7	.111	26.3	20.5	.138	32.1	26.3
.085	20.7	14.9	.112	26.5	20.7	.139	32.3	26.5
.086	20.9	15.1	.113	26.7	20.9	1.140	32.5	26.7
.087	21.2	15.4	.114	26.9	21.1	.141	32.8	27.0
.088	21.4	15.6	.115	27.2	21.4	.142	33.0	27.2
.089	21.6	15.8	.116	27.4	21.6	.143	33.2	27.4
1.090	21.8	16.0	.117	27.6	21.8	.144	33.4	27.6
.091	22.0	16.2	.118	27.8	22.0	.145	33.6	27.8
.092	22.2	16.4	.119	28.0	22.2	.146	33.8	28.0
.093	22.4	16.6	1.120	28.3	22.5	.147	34.1	28.3
.094	22.7	16.9	.121	28.5	22.7	.148	34.3	28.5
.095	22.9	17.1	.122	28.7	22.9	.149	34.5	28.7
.096	23.1	17.3	.123	28.9	23.1	1.150	34.7	28.9
.097	23.3	17.5	.124	29.1	23.3	.151	34.9	29.1
.098	23.5	17.7	.125	29.3	23.5	.152	35.1	29.3
.099	23.7	17.9	.126	29.5	23.7	.153	35.4	29.6
1.100	24.0	18.2	.127	29.8	24.0	.154	35.6	29.8
.101	24.2	18.4	.128	30.0	24.2	.155	35.8	30.0
.102	24.4	18.6	.129	30.2	24.4	.156	36.0	30.2
.103	24.6	18.8	1.130	30.4	24.6	.157	36.2	30.4
.104	24.8	19.0	.131	30.6	24.8	.158	36.4	30.6
.105	25.0	19.2	.132	30.8	25.0	.159	36.6	30.8
.106	25.2	19.4	.133	31.0	25.2	1.160	36.9	31.1

SPECIFIC GRAVITY, SUGAR CONTENT, AND BOILING-POINT OF MAPLE SUGAR.

(COOKE AND HILLS.)

Degrees, Baumé Hydrometer.	Specific Gravity.	Degrees, Brix Hydrometer.	Approximate per cent of Pure Sugar.	Temperature of Boiling-point.	Weight per Gallon.	Relative Value per Gallon.
25	1.205	44.9	41	215.0° F.	10.0 lbs.	68
26	1 215	46.8	43	215.1	10.1	72
27	1.226	48.7	45	215.3	10.2	75
28	1.236	50.5	47	215.6	10.3	78
29	1.246	52.4	49	215.9	10.4	82
30	1.257	54.3	51	216.2	10.5	85
31	1.268	56.2	53	216.6	10.6	88
32	1.279	58.1	54	217.0	10.7	90
33	1.290	60.0	56	217.4	10.7	93
34	1.302	62.0	58	218.1	10.8	97
35	1.313	63.9	60	218.6	10.9	100
36	1.325	65.8	62	219.5	11.0	103
37	1.337	67.8	64	220.3	11.1	107
38	1.350	69.8	66	221.2	11.2	110
39	1.362	71.8	68	222.0	11.3	113
40	1.374	73.7	70	223.2	11.4	117
41	1.387	75.7	72	224.5	11.6	120
42	1.400	77.7	74	226.0	11.7	123
43	1.415	79.8	75	227.8	11.8	125
44	1.428	81.8	77	229.7	11.9	128
45	1.442	83.9	79	231.8	12.0	132
46	1.457	86.0	81	234.0	12.1	135
47	1.471	88.1	83	236.3	12.3	138
48	1.486	90.2	85	238.7	12.4	142

"The per cents of sugar given are calculated for a fairly good syrup. The relative values in the last column are based on these per cents, but will be nearly the same for all except the poorest of syrups. The relative value is made use of as follows: A weight of 11 pounds per gallon, and 35° Baumé is taken as the standard; dividing the weight of the syrup by 11 gives the number of standard gallons; multiplying the price that is to be paid for 11-pound syrup by the relative value figure, and dividing by 100, gives the price to be paid per standard gallon.

"*Example:* If 75 cents a gallon is to be paid for 11-pound

syrup, how much should be paid for 671 pounds of syrup testing 31° by the Baumé hydrometer?

671 ÷ 11 = 61 standard gallons.

75 × 88 ÷ 100 = 66 cents per gallon.

61 × 66 = $41.26, price to be paid."

WEIGHT OF SUGAR OBTAINED FROM 100 LBS. OF MAPLE SYRUP

Weighing 11 lbs. to the Gallon, when Sugared Off at Different Temperatures. (Cooke and Hills.)

Temperature of Sugaring Off.	Aver. Weight of Sugar.	Highest Weight of Sugar.	Lowest Weight of Sugar.	Temperature of Sugaring Off.	Aver. Weight of Sugar.	Highest Weight of Sugar.	Lowest Weight of Sugar.
° Fahr.	Lbs.	Lbs.	Lbs.	° Fahr.	Lbs.	Lbs.	Lbs.
232	82.7	82.0	83.3	238	79.5	78.5	80.7
233	81.9	80.5	82.8	239	79.2	78.4	80.3
234	81.2	80.0	81.9	240	78.7	78.2	79.7
235	80.8	79.5	81.6	241	78.5	77.9	79.3
236	80.5	79.5	81.1	242	78.1	77.4	78.9
237	80.0	79.0	80.9				

TEMPERATURES TO WHICH PERISHABLE GOODS MAY BE SUBJECTED WITHOUT INJURY. (U. S. DEPARTMENT OF AGRICULTURE.)

Name of Article.	Lowest Outside Temperature. In Ordinary Pkgs. Unprotected.	In Ordinary Freight Cars.	In Refrigerator or Specially Prepared Cars.	Temperatures above which Injury Occurs.	Remarks.
	° F.	° F.	° F.	° F	
Apples, in bbls.......	20	10	−10	75	Covered with straw.
" loose	28	15	−10	75	Packed in straw.
Apricots, baskets....	35	24	10	70	
Asparagus....... ...	28	22	....	70	In boxes covered with moss.
Bananas	50	32	..	90	Bulk or boxes with straw.
Beans, snap....... ..	32	26	....	65	In barrels or crates.
Beets.	26	20	....	70	In crates.
Cabbage, early or late	25	20	zero	75	Barrels or crates.
Cantaloupes.	32	25	10	80	
Cauliflower	22	15	.. .	70	In barrels with straw.
Celery	10	zero	....	65	Packed in crates.
Cheese.	30	25	10	75	
Cranberries..	28	20	zero	...	
Cucumbers	32	20	..	65	In boxes with moss.
Eggs, bbl'd or crated	30	20	zero	80	
Fish.	10	zero	....	65	In barrels always iced.
Flowers.	35	20	−10	....	Packed in moss.
Grapes.	34	20	zero	....	Packed in cork.
Kale	15	zero	....	65	Packed in boxes or crates.
Leek	28	20	...	65	Packed in boxes.
Lemons.	32	20	10	75	In boxes or crates.
Lettuce.	26	15	....	70	In boxes or crates.
Mandarins......... ..	32	20	zero	75	In boxes.
Milk	32	28	zero	75	
Olives, in bulk.......	28	25	zero	...	In barrels.
" " glass	25	20	zero	....	
Onions, boxes...	20	15	zero	....	
Onions.......... ...	20	10	....	80	In barrels, boxes, or crates.
Oranges......	28	20	zero	80	Baskets, boxes, bbls., or crates.
Parsley	32	20	....	75	In baskets.
Parsnips....	32	20	....	70	In baskets or barrels.
Peaches, fresh, b'skets	32	20	10	80	
Peas.	32	20	....	80	In baskets or barrels.
Pineapples	32	25	zero	75	In barrels, crates, or in bulk.
Plums	35	32	zero	75	In boxes with paper.
Potatoes, Irish......	35	25	10	80	In barrels or baskets.
" sweet......	35	28	10	80	In barrels or baskets.
Radishes....	20	15	....	65	In baskets.
Rice.	20	10	...	90	In baskets or sacks.
Shrubs, roses, or trees	35	10	−10	....	In canvas or sacking.
Spinach.	15	15	....	75	In barrels or crates.
Strawberries........	33	25	−10	65	
Tangerines..	25	15	zero	70	In boxes.
Thyme..........	20	10	....	90	In small baskets.
Tomatoes, fresh......	33	28	10	90	
Turnips, late.........	15	zero	....	75	In barrels.
Watermelons	20	10	....	85	In barrels and in bulk.

VI. SEEDS.

SEED-TESTING FOR THE FARMER.

By GILBERT H. HICKS, in charge of Seed Investigations, U. S. Department of Agriculture.

Not less important than good soil and suitable cultivation is seed of the best obtainable quality. In no feature of farm practice is niggardly economy or lack of proper attention more productive of disappointment and loss than in the failure to provide proper seed for sowing. The market gardener is fully alive to this fact, and makes the purchase of desirable seed his foremost care. He wants not only seed which will grow, but also that which will produce an even stand and yield a large crop of the very best vegetables. The matter of paying a few cents or even a dollar extra per pound is to him of no significance, since he knows by long experience that the increased value of his crop will far outweigh the extra cost of the seed.

With many farmers this care in the selection of seed is often lacking. Frequently the land is all tilled and ready for sowing before the seed is bought. It is then too late to give it a careful preliminary test, even if the owner desired to do so. This results very often in a poor stand, perhaps in a failure of the crop, or in the scattering of hordes of weeds all over the farm, which usurp the place of the cultivated plants, and cost infinite trouble in their eradication. This is especially noticeable in the case of the clovers, grasses, and other forage plants. No matter how poor the seed turns out to be, after once sown it is too late to secure any redress from the seedsman. Besides, there are very few places in this country where one can get seed tested in order that its real value may be ascertained before sowing. It becomes, then, a matter of great importance to the farmer to provide himself with some

simple but efficient means for testing his seed before it is sown.

All seed which is to be used for spring sowing should be procured whenever possible in the previous fall or winter. The long winter months will give ample opportunity for close examination of the seed, and if any of it be found of inferior quality, as will not infrequently prove to be the case, there will be plenty of time to replace it with a desirable article. In all cases seed should be bought of the most reliable seedsmen. In many instances it will pay to get seed from the large dealers, as they have first-class opportunities for handling the very best seed in the country. The extra cost for carriage will be a small item compared with the chance for obtaining good seed.

No matter from what source the seed is obtained, nor how reliable the dealer, every farmer should test each lot of seed he expects to plant. Besides learning its quality, he will often obtain valuable information concerning the depth, temperature, and amount of moisture needed, etc. Furthermore, if the seed fails to come up well, the planter will have some intelligent data for ascertaining the reason, and will not be obliged to depend entirely upon the statement of seed catalogues, which convey the impression that failure to germinate is more likely to be the fault of the outdoor conditions than of the seed itself.

Good seed is marked by three characteristics : *purity*—or freedom from foreign matter, whether seeds of weeds or other plants ; *vitality*—or capacity for sprouting under favorable conditions ; and *genuineness*—or trueness to name. If any of these qualities be lacking, the seed is unworthy of general trial.

Purity.—Most vegetable seeds, especially if grown in America, are quite free from admixture. Seed of the cabbage family, however, if grown abroad, and sometimes that of American origin, may contain a mixture of wild mustard or similar seed, often so near like the good seed as to be almost indistinguishable from it.

Clover and grass seed is very likely to contain more or less seed of noxious weeds or inferior grasses ; hence a

careful purity test is necessary in such cases. Hairy vetch and other leguminous forage seeds, excepting the clovers, generally come from Europe and are frequently impure. Often it will require considerable care to detect impurities in the seeds of forage plants, and in case of any doubt samples of such seed should be sent to the nearest experiment station or to the Department of Agriculture for examination.

Purity tests are usually made by weighing out a few ounces of seed which has been well stirred up so as to make the sample uniform. This seed is placed upon a pane of glass under which is a piece of light-colored paper, and the sample is carefully gone over seed by seed with a small forceps until all the impurities are separated out. After again weighing, the percentage of impurity is easily obtained. If the impurity consists of chaff or dirt, the loss will consist only in paying for something which will not grow. This will render necessary the sowing of more than the usual amount of seed to the acre. If weed seeds are present, there will be greater or less loss according to the character of the weeds. Such seeds as Canada thistle, dodder, Russian thistle, chess, wild mustard, cockle, plantain, black medic, daisy, penny-cress, wild carrot, wild oats, and a few others, are serious pests. Every farmer should be able to recognize these weed seeds, and avoid all seed which contains any of them even in small amounts. He should also be familiar with the ordinary grass seeds of trade, such as June grass, orchard grass, the common fescues, red top, tall meadow oat grass, etc. Grass-seed mixtures almost invariably contain a large proportion of seed of inferior, if not worthless, species, dirt, and chaff, and should be avoided. It is much better to find out what grasses are adapted to one's fields or pastures and to buy such seed separately, mixing it at home.

If scales are not at hand, the amount of pure seed in a given sample can be approximately learned by placing the pure seed in a small bottle with the impurities in another bottle of similar shape and size. The names of the foreign

seeds may be learned from some botanist or experiment station.*

After determining the per cent of pure seed in a sample, the *germinative ability* should be ascertained. This is even more important. One can judge fairly well of the purity of seed by a casual inspection, but no one can tell by its looks whether a seed is capable of sprouting or not. Considering the great amount of labor and expense involved, it is surprising that so few farmers test their vegetable and field seeds before they are sown.

Even fresh seed is sometimes incapable of germination through improper care in harvesting or cleaning. Nor can fresh seed be told by its appearance with certainty. Add to this the fact that old seed is frequently offered for sale, and there is no lack of reason for testing the sprouting capacity of the seed one intends to sow.

If the heat and moisture are properly controlled, seed-testing will be found a very simple matter. Seventy to eighty degrees Fahrenheit must be maintained during the day, with a fall of not more than twenty degrees at night, and the seed must be kept constantly damp, but not wet. A good plan is to plant a hundred seeds of average quality —that is, an average number of large, small, plump, and shrivelled ones, etc.—in moist soil in a box or in a small flower-pot which is set inside of a large pot also containing soil. Water as needed is added from time to time in the larger pot and the whole is kept covered so as to prevent evaporation and sudden cooling. When the seeds begin

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* The following *standards of purity* are adopted by the U. S. Department of Agriculture :

Asparagus, beans, buckwheat, cabbage, cauliflower, celery, collards, Indian corn, cow pea, cucumber, eggplant, lettuce, melon, millet (common and pearl), oats, okra, onion, peas, pumpkin, radish, rutabaga, salsify, squash, tomato, turnip, vetch (hairy)	99 per cent.
Alfalfa, beets, crimson clover, red clover, cotton, Kafir corn, parsley	98 " "
Parsnip	97 " "
Hungarian brome grass, carrot, white clover, alsike clover	95 " "
June grass, poa compressa	90 " "

to come up, the pots should be exposed to the light. After about two weeks for most seeds the seedlings are counted and the percentage of sprouts ascertained. If the soil has been previously heated to kill all weed seeds, and proper precautions have been taken, such a test will give a good indication of the value of the seed. To make sure, a duplicate lot of one hundred seeds should be tested at the same time under the same conditions and the results compared. If the variation exceeds ten per cent, the tests should be repeated until the source of error is discovered. Grasses and very fine seed will require more care than other kinds. Such seed should be barely covered with soil, while in all cases too deep planting must be avoided. Some hard-coated seeds may be soaked a few hours in warm water, but as a usual thing it is better not to do so.

Seeds of clovers and most vegetables can be easily germinated between two folds of damp flannel cloth placed between two plates. Such tests permit frequent inspection of the seed, which should be thrown away as fast as it germinates, count being kept of the same. Damp blotters, porous dishes, and various kinds of especially prepared germinating apparatus are sometimes used in seed-testing. The amount of moisture to be given varies greatly with the variety of seed and can be best learned by experience. In general, quick-sprouting seeds, like clover, cabbage, radish, etc., will stand more moisture than those varieties which sprout more slowly.

To make sure of the vitality of seed it is better to test it in the soil, as previously suggested, and also by the cloth or plate method. Soil tests should be continued a few days longer than those made between cloth or blotters. There is considerable difference of opinion as to the standards of germination to which first-class seed should attain. Those in use at present by the U. S. Department of Agriculture are given in the first table on page 77. While first-class seeds should reach the standards referred to, it may be said that seed which falls as much as ten per cent below them need not be rejected as bad.

TABLE OF GERMINATION STANDARDS.

(U. S. Dept. of Agriculture.)

Seed.		Seed.		Seed.	
Asparagus	85	Cucumber	90	Okra	90
Beans, bush	95	Egg-plant	80	Onion	85
" lima	95	Endive	94	Parley	75
Beet	150	Gherkin	92	Parsnip	75
Borecole	95	Grasses:		Peas	98
Broccoli	85	English blue	50	Pepper	85
Brussels sprouts	95	Fowl meadow	75	Pumpkin	90
Buckwheat	95	Johnson	75	Radish	95
Cabbage	95	Hungarian brome	80	Rape	95
Carrot	85	Kentucky blue	50	Rhubarb	85
Cauliflower	85	Meadow fescue	80	Rutabaga	95
Celeriac	65	Orchard	80	Salsify	83
Celery	65	Texas blue	50	Sorghum	90
Chicory	85	Timothy	90	Spinach	89
Clover, alfalfa	90	Kafir corn	90	Spurry	90
" alsike	80	Rohl-rabi	90	Squash	90
" red	90	Leek	85	Sunflower	90
" scarlet	95	Lettuce	90	Tobacco	88
" white	80	Lupin yellow	90	Tomato	90
Collards	95	Melon	90	Turnip	95
Corn	90	Millet, common	90	Vetch, hairy	90
Cotton	90	" pearl	90	Wheat	95
Cowpea	90	Mustard	95		
Cress	90	Oats	90		

NUMBER, WEIGHT, COST OF GRASS SEEDS, AND AMOUNT TO SOW PER ACRE.

(Yearbook U. S. Dept. of Agriculture.)

[Columns 1, 2, 3, and 4 are compiled from "The Best Forage Plants," by Stebler and Schroeter. The figures in column 5 are obtained by multiplying the amount of standard quality of seed required (col. 2) by the retail price quoted in N. Y. catalogues. The weight of 10,000,000 grains (col. 6) is obtained by dividing this quantity by the number of seeds in one pound (col. 1).]

No.	Name.	(1) Number of Grains per lb. of Pure Seed.	(2) Amount to Sow per Acre in lbs., Standard Quality.	(3) Amount to Sow per Acre in lbs. of Pure Germinating Seed.	(4) Weight per Bushel.	(5) Cost of Seed per Acre.	(6) Weight of 10,000,000 Grains, lbs.
1	Redtop (Agrostis alba)	603,000	9.7	7.00	8–32	$1.45	16.58
2	Reed canary grass (Phalaris arundinacea)	660,000	21.0	12.00	44–48	7.35	15.15
3	Smooth-stalked meadow grass (Poa pratensis)	2,400,000	17.5	8.40	.....	2.10	4.17
4	Rough-stalked meadow grass (Poa trivialis)	3,000,000	19.5	8.75	11–17	4.88	3.33

NUMBER, WEIGHT, COST OF GRASS SEEDS, AND AMOUNT TO SOW PER ACRE—*Continued.*

No.	Name.	(1) Number of Grains per lb. of Pure Seed.	(2) Amount to Sow per Acre in lbs., Standard Quality.	(3) Amount to Sow per Acre in lbs. of Pure Germinating Seed.	(4) Weight per Bushel.	(5) Cost of Seed per Acre.	(6) Weight of 10,000,000 Grains, lbs.
5	Sheep's fescue (Festuca ovina)	680,000	28.0	12.60	10-15	$4.20	14.85
6	Various-leaved fescue (Festuca heterophylla)	400,000	33.5	19.50	......	8.38	25.00
7	Creeping fescue (Festuca rubra)	600,000	42.5	13.00	10-15	8.50	16.67
8	Awnless brome grass (Bromus inermis)	137,000	44.0	35.60	......	8.80	72.99
9	Perennial rye grass (Lolium perenne)	336,800	55.0	38.50	18-30	4.95	29.70
10	Italian rye grass (Lolium italicum)	285,000	48.5	32.40	12-24	3.56	35.10
11	Orchard grass (Dactylis glomerata)	579,500	35.0	....	12-16	5.60	17.25
12	Meadow fescue (Festuca pratensis)	318,200	52.0	....	12-26	7.80	31.42
13	Meadow oat grass (Arrhenatherum avenaceum)	159,000	70.0	34.30	10	12.60	62.89
14	Yellow oat grass (Trisetum flavescens)	2,045,000	29.0	4.64	5.5	24.65	4.89
15	Velvet grass (Holcus lanatus)	1,304,000	22.0	8.80	6.5	4.40	7.66
16	Timothy (Phleum pratense)	1,170,500	16.0	14.00	48	1.50	8.54
17	Meadow foxtail (Alopecurus pratensis)	907,000	23.0	6.21	6	6.21	11.02
18	Vernal grass (Anthoxanthum odoratum)	924,000	30.0	7.80	......	15.00	10.82
19	Crested dog's tail (Cynosurus cristatus)	1,127,000	25.0	13.50	20-32	7.50	8.87
20	Alsike clover (Trifolium hybridum)	707,000	12.3	9.00	94-100	1.60	14.14
21	Sainfoin (Onobrychis sativa)	22,500	78.0*	60.84*	40	6.25	444.44
22	Red clover (Trifolium pratense)	279,000	18.0	15.84	64	2.50	35.84
23	White clover (Trifolium repens)	740,000	10.5	7.50	63	2.94	13.51
24	Common kidney vetch (Anthyllus vulneraria)	154,000	17.5	15.00	60-64	4.58	67.15
25	Alfalfa, or lucern (Medicago sativa)	209,500	25.0	22.00	61-63	3.25	48.56
26	Trefoil (Medicago lupulina)	328,000	18.0	14.75	64-66	2.16	30.48
27	Bird's-foot trefoil (Lotus corniculatus)	375,000	11.0	4.67	60	4.40	26.66
28	Officinal goat's rue (Galega officinalis)	62,000	22.0	6.90	......	4.14	161.29

* Unshelled.

NOTES ON ADAPTABILITY AND USES OF PRECEDING GRASSES AND CLOVERS.

No. 1. Requires moist climate or damp soil. Best propagated by transplanting small turf cuttings in autumn. Valuable for late pasturage or lawns in the New England and Middle States. Use 5–10 per cent in mixtures.

No. 2. Adapted to stiff, wet lands and flooded fields. Requires moisture. Valuable hay when cut young, and well suited for binding loose banks near running water or for forming a firm sod on marshy ground.

No. 3. Grows best on strongly calcareous soils. Well adapted for pasture, and makes a good bottom grass for meadows. An excellent lawn grass.

No. 4. Should be sown only on moist, fertile, and sheltered soils in mixtures.

No. 5. Light, dry soils, especially those which are poor, shallow, and silicious. Valuable bottom grass and for sheep pastures. Sown only in mixtures.

No. 6. Best on moist, low lands containing humus and sandy loams. Withstands drought; useful in pasture; unimportant for hay. Alone it makes no continuous turf.

No. 7. Valuable pasture or bottom grass. Withstands drought; endures both cold and shade. On poor land, especially moist sands and railway banks, serves to bind the soil. Product small.

No. 8. Valuable for light soils, especially in regions subject to extremes of heat or long periods of drought. Used alone or in mixtures for permanent meadows and pastures.

No. 9. Excellent and lasting pasture grass for heavy soils in moist, cool climates. On light, dry soils disappears after the second year. Rarely sown alone.

No. 10. Excellent for rich and rather moist lands. Regarded in Europe as one of the best for hay. Lasts only two or three years.

No. 11. Grows well on any soil, excepting that which is very wet; withstands shade. Affords a large amount of aftermath. Valuable alike for hay and pasturage.

No. 12. Thrives in either dry or wet soils. Valuable hay or pasture grass.

No. 13. Thrives on moist, loamy sands or light clays which are not too moist, and marls. Spring most favorable seed-time. Valuable in the South for hay and winter pasture.

No. 14. Valuable for temporary or permanent pastures. Thrives on marly or calcareous soil, in all light land rich in humus.

No. 15. Sometimes sown on light, thin soils unsuited for more valuable sorts. Rarely used excepting in mixtures.

No. 16. Best known and most extensively cultivated for hay. Sown alone or mixed with redtop or clover. Succeeds best on moist loams or clays. On dry ground the yield is light.

No. 17. Endures cold. Likes strong soil, stiff loam, or clay. One of the best grasses for land under irrigation. Very early. Two to four pounds in mixtures for permanent pastures.

No. 18. Grows on almost any kind of soil; sown only in mixtures, 1 to 2 pounds, with permanent pasture or meadow grasses.

No. 19. Especially adapted for loams, light clays, marls, and moist, loamy sands. Moist climates are most suitable. Withstands drought and thrives well in shade. Nutritive value high. Used in mixtures to form bottom grass either in pasture or hay.

No. 20. Grows on strongest clay or peaty soil; peculiarly adapted to damp ground. Bears heavy frosts without injury. Sown in August or February.

No. 21. Requires good and open subsoil, free from water. Sown alone, from end of March to beginning of May.

No. 22. Succeeds best in rich, loamy soil, on good clays, and on soils of an alluvial nature. A standard fodder plant.

No. 23. Thrives on mellow land containing lime, and on all soils rich in humus. Resists drought. Generally used in mixtures for pastures or lawns.

No. 24. Cultivated for grazing; on warm soils, if manured

and of proper depth. Hardy; resists drought. Sheep, goats, and horned cattle eat it greedily.

No. 25. Grows well on any calcareous soil having a permeable subsoil. Especially adapted to the warm and dry regions of the West and Southwest. Requires irrigation.

No. 26. Any soil containing sufficient moisture and lime is suitable. Most successful on clay marls. Cultivated only where the better kinds of clover cannot be grown.

No. 27. Thrives on dry or moist, sandy or clayey soils. Well suited to dry lands at high elevations, though poor.

No. 28. Excellent fodder plant for warm, sheltered situations. Thrives only in deep soil, and when subsoil is not wet.

VII. WEEDS.

TABLE OF NOXIOUS WEEDS.*

(By L. H. Dewey, Assistant Botanist U. S. Department of Agriculture.)

Note 1.—The table presents the common and technical name, with some of the characteristics, of fifty-five weeds which are regarded as the most troublesome in the United States.

Note 2.—By alternate cultivation and smothering crops is meant clean cultivation during the dry season and a heavy seeding of some annual crop, as crimson clover, cow peas, millet, or oats, that will cover the ground thickly and choke down the weeds during the growing season.

Note 3.—[1] Annual plant; [2] biennial plant; [3] perennial plant.

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Barn grass, barnyard grass, cocksfoot.	Panicum crus-galli [1]..	Minn. to Mont.	July to Sept.	Seeds; in grain seed.	Fields; spring wheat.	Prevention of seeding.
Bindweed, morning-glory.	Convolvulus arvensis	Me. to Kan. and Cal.	Aug. to Oct..	Seeds; root stocks.	Grain fields; hoed crops.	Late cultivation; spudding.
Black mustard.........	Brassica nigra [1]	Wash. to Cal...	July to Oct..	Seeds; in grass and grain seed	Fields; grain crops.	Prev. of seeding; hoed crops.
Buffalo bur, beaked horse nettle.	Solanum rostratum [1].	Ia. to Colo.....	July to Nov..	Seeds; tumble-weed.	Grain; hoed crops.	Heavy seeding; close cultiv.
Bull thistle, common thistle.	Carduus lanceolatus [2]	Me. to Mo.....	.....do.....	Seeds; wind...	Meadows; winter wheat.	Prev. of seeding; cutting in fall.
Burdock, great dock...	Arctium lappa [2]	Me. to Wis....	Aug. to Oct..	Seeds; animals	Waste places; pastures; wool	Prev. of seeding; grubbing in summer.
Bur grass, hedgehog grass, sand bur.	Cenchrus tribuloides[1]	Everywhere. .	July to Nov..	.......do......	Sandy pastures; wool.	Cultiv.; burning.
Buttonweed, poorweed	Diodia teres[1].........	Md. to Ala....	.....do. ..	Seeds..........	Waste places; hoed crops; grainfields.	Prev. of seeding; close cultivation.

Canada thistle, cursed thistle.	Carduus arvensis[3]...	Me. to Mich. and Ore.	July to Oct...	Seeds; wind; running roots.	Fields; grain; meadows.	Alternate cultiv. and heavy cropping; spudding
Charlock, wild mustard	Brassica sinapistrum[1]	Me. to Ore....	June to Oct..	Seeds; in grain seed.	Fields; grain..	Prev. of seeding; cultiv.; hoed crops.
Chess, cheat....	Bromus secalinus[1]...	Me. to Wash...	July to Aug..	......do... ..	.......do...	Clean seed.
Clover dodder, devil's gut, dodder.	Cuscuta epithymum[1]	N. Y. to N. C. and westward	June to Nov.	Seeds; in clover and alfalfa seed.	Clover; alfalfa	Clean seed; rotation of crops.
Cockle, corn cockle, rose campion.	Agrostemma githago.[1]	Me. to Wash...	July to Sept..	Seeds; in grain seed.	Grainfields; wheat.	Clean seed.
Cocklebur, clot bur....	Xanthium canadense[1]	Everywhere....	Aug. to Nov.	Seeds; animals.	Waste places; pastures; wool	Prev. of seeding; cultivation.
Corn, gromwell, wheat thief, pigeonweed, redroot.	Lithospermum arvense.[1]	Mich. to Ohio..	July to Oct..	Seeds; in grain seed.	Grainfields....	Sowing clean seed; cultiv. with hoed crops
Couch grass, quack grass, witch grass, quick grass.	Agropyrum repens[3]..	Me. to Minn...	Aug. to Sept.	Rootstocks....	Fields; all crops except hay.	Alternate cultiv. and heavy cropping.
Curled dock, yellow dock.	Rumex crispus[3].. ..	Me. to Wash...	July to Oct .	Seeds....... ..	Meadows; grain crops.	Alternate cultiv. and heavy cropping.
Dandelion...........	Taraxacum taraxacum.[1]	All States......	May to Nov..	Seeds; carried by wind.	Meadows; pastures; lawns.	Cultiv.; repeated spudding in lawns.
Dog fennel, Mayweed.	Anthemis cotula[1]....	Everywhere....	July to Sept..	.......do......	Roadsides......	Prev. of seeding.
Horse nettle, bull nettle, sand briar.	Solanum carolinense[3]	Ia. to N. J. and south.	Aug. to Nov.	Seeds; running roots.	Waste land; meadows; pastures.	Alternate cultiv. and heavy cropping.
Horseweed, butterweed, colt's tail, fleabane.	Erigeron canadensis[1]	Everywhere....	July to Oct..	Seeds; wind..	Waste land; meadows; grainfields.	Prev. of seeding; late cultivation.

* Condensed and re-edited by the author from *Table of Two Hundred Weeds*, U. S. Dept. of Agriculture Yearbook, 1895.

TABLE OF NOXIOUS WEEDS.—(*Continued.*)

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Manroot, man-of-the-earth, morning-glory.	Ipomœa pandurata.[3]	Del. to Mo....	Aug. to Oct..	Seeds.........	Fields.	Prev. of seeding; killing roots with coal-oil.
Mexican tea, pigweed..	Chenopodium ambrosioides.[1]	Va. to La	.... .do......	.......do......	Waste places ..	Prev. of seeding.
Milkweed, cottonweed, silkweed.	Asclepias syriaca[3].. .	N. Y. to Neb...	Aug. to Sept.	Seeds; wind; running roots	Fields..........	Prev. of seeding; cultiv.; heavy cropping.
Narrow-leafed stick-seed, beggar tick.	Lappula lappula[1]....	Everywhere...	July to Oct..	Seeds; animals.	Everywhere; all crops.	Sowing clean seed; cultiv.
Nut grass, nut sedge, coco, coco sedge.	Cyperus rotundus[5]..	Va. to Tex.....	Aug. to Nov..	Tubers; in nursery packing: seeds.	In hoed crops.	Alternate cultiv. and smothering crops.
Orange hawkweed, ladies' paint brush, red daisy.	Hieracium aurantiacum.[3]	N. Y. to Me....	Aug. to Oct..	Seeds; wind; rootstocks.	Meadows; pastures.	Prev. of seeding cultivation.
Ox-eye daisy, bull's-eye, white daisy, whiteweed.	Chrysanthemum leucanthemum.[3]	Me. to Va. and Ohio.	Ju'y to Oct...	Seeds; rootstocks.	.......do.......	Do.
Paroquet bur..........	Sida stipulata[1].... ..	Ala. to Fla. ..	July to Dec..	Seeds; animals.	Waste places; cultivated land; wool.	Cultivation.
Pennycress, French-weed.	Thlaspi arvense[1]...	N. D. to Minn. and Ohio.	June to Dec..	Seeds; wind...	Grainfields; pastures; dairy products.	Burning; thorough cultivation.
Pigeon grass, foxtail, yellow foxtail.	Setaria glauca[1]......	Everywhere....	July to Nov..	Seeds; in clover seed.	Cultivated land; grain crops.	Do.

Pigweed, rough amaranth.	Amaranthus retroflexus.[1]	......do......	Aug. to Nov..	Seeds	Cultivated land; all crops.	Prev. of seeding; thorough cultivation.
Prickly lettuce, compass plant, milkweed, wild lettuce.	Lactuca scariola [1]....	Ohio to Ia. and U. to Ore.	July to Nov..	Seeds; wind....	Everywhere; all crops.	Prev. of seeding; burning.
Purslane, garden purslane, pursley, pusley.	Portulaca oleracea [1] .	Everywhere....	June to Dec..	Seeds	Cultivated land; garden crops.	Closer cultivation.
Ragweed, bitterweed, hogweed, richweed, Roman wormwood.	Ambrosia artemisiæfolia.[1]	.......do.... ..	Aug. to Nov.	Seeds; wind...	Everywhere; all crops.	Prev. of seeding; burning.
Ramsted, snapdragon, toad flax.	Linaria linaria	Me. to Wis. and southward.	Aug. to Dec..	Seeds in grass seed; rootstocks.	Meadows and pastures.	Cultivation; spudding; cropping.
Rib grass, black plantain, buckhorn, ripple grass.	Plantago lanceolata.[3]	Nearly everywhere.	July to Nov..	Seeds; in grass seed.	Everywhere; all crops.	Clean seed; cultivation.
Russian thistle, Russian tumbleweed.	Salsola kali tragus [1]..	Mich. to Colo..	Aug. to Nov.	Seeds; wind....	Everywhere; small grain.	Cultivation; burning.
Shepherd's purse, pickpurse, toothwort.	Bursa bursa-pastoris[1]	Everywhere....	May to Dec..	Seeds....	Everywhere; all crops.	Cultivation.
Smartweed, knotweed.	Polygonum pennsylvanicum[1].	Ohio to Neb....	Aug. to Sept.	.......do... ...	.......do.	Prev. of seeding; cultivation.
Sorrel, field sorrel, horse sorrel, sourweed.	Rumex acetosella [3]...	Nearly everywhere.	June to Nov..	Seed, in clover seed; rootstocks.	Meadows; pastures.	Cultiv.; smothering crops.
Spiny cocklebur, Chinese thistle.	Xanthium spinosum [1]	Md. to Tex. and Cal.	Aug. to Nov.	Seeds; animals.	Waste land; pastures; wool	Prev. of seeding: cultivation.
Squirrel tail, foxtail, wild barley.	Hordeum jubatum [1]..	Tex. to Mont	July to Oct..	Seeds; wind; animals.	Pastures..... .	Do.
Sunflower, common sunflower.	Helianthus annuus[1]..	Neb. to La. and Tex.	Aug. to Oct..	Seeds	Cultivated land.	Prev. of seeding.
Sweet clover, Bokhara clover.	Melilotus alba[3]	Md. to Mich...	July to Sept..	Roots, seeds; in hay and clover seed.	Clay soil; meadows and hoed crops.	Plowing in July and Aug.

TABLE OF NOXIOUS WEEDS.—(*Continued.*)

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Wild buckwheat, black bindweed.	Polygonum convolvulus.[1]	Mich. to N. D..	July to Oct..	Seeds, in grain seed.	Grain and corn fields.	Sowing clean seed; cultiv.
Wild carrot, bird's nest, devil's plague.	Daucus carota[2]......	Me. to Va. and Ind.	July to Nov..	Seeds; animals; wind.	Meadows; pastures.	Grubbing in fall; cultivation.
Wild licorice	Glycyrrhiza lepidota[3]	Minn. to Cal...	Aug. to Nov..	Running rootstocks; seeds; burs carried by animals.	Open prairie; burs very injurious in wool.	Subsoiling in dry weather; persistent cultiv. during three successive seasons.
Wild oats............ .	Avena fatua[1]	Minn. to Cal...	July to Sept..	Seeds, in seed oats.	Oatfields.......	Sowing clean seeds; burning; pasturing.
Wild onion, field garlic, wild garlic.	Allium vineale[3]......	Penn. to S. C..	Aug to Sept.	Bulblets; seeds.	Everywhere; dairy products; grain.	Alternate cultiv. and heavy cropping.
Yard grass, wire grass, crab grass.	Eleusine indica[1].....	N. J. to Tex....	Aug. to Nov.	Seeds; carried by animals.	Grain fields and vineyards.	Cultiv., with hoed crops.
Yellow daisy, brown-eyed Susan, nigger-head.	Rudbeckia hirta[2]	Me. to Ohio....	July to Sept..	Seeds....	Meadows; pastures.	Prev. of seeding; cultivation.
Yellow dock, broad-leafed dock.	Rumex obtusifolius.[3]	Me. to Wis....	Aug. to Oct..	... ...do.......	,......do.......	Do.
Yellow dog fennel	Helenium tenuifolium.[1]	Tex. to Ga	Aug. to Nov.	.......do.......	Waste land; pastures.	Do.
Yellow melitot; yellow sweet clover.	Melilotus officinalis.[1]	Md. to Mich....	July to Oct...	Seeds; in hay and clover seeds.	Clay soil; dry meadows and pastures.	Cultiv.;increased fertilization; re-seeding meadows.

VIII. ENEMIES OF FARM CROPS.

TREATMENTS FOR INJURIOUS INSECTS AND FUNGOUS DISEASES OF PLANTS.

By Prof. E. S. GOFF, of Wisconsin Experiment Station.

The value of the following treatments for preventing injury to crops from insects and fungous diseases has been proved by abundant experience. It is essential that the treatments be given *promptly* and *thoroughly*. In the case of fungous diseases, it is generally essential that the applications be made *before the disease appears*, since they are preventive, rather than curative. *The treatments considered most important are printed in italics*. As a rule, those not so printed need be given only in seasons or localities in which the attack is serious.*

Formulas.

No. 1. *Bordeaux Mixture.*—Place 6 pounds of copper sulfate in a cloth sack and suspend this over night in a wood vessel containing 4 gallons of water, immersing the sack. In another wood vessel slake 4 pounds of fresh lime in as many gallons of water. When the lime is cool, pour it and the copper sulfate solution into a barrel and add enough water to make 40 gallons. Apply at once with a force-pump, with spraying nozzle, stirring frequently during the application.

No. 2. *Ammoniacal Copper Carbonate.*—Dissolve 1 ounce of copper carbonate in 3 pints of strong ammonia and add this solution to 25 gallons of water. Apply as in No. 1. No stirring is required.

No. 3. *Copper Sulfate Solution.*—Dissolve, as directed in No. 1, 1 pound of copper sulphate in 15 gallons of water. Apply as in No 2.

No. 4. Stir 4 ounces of *Paris green* in 40 gallons of water, and add ½ pound of fresh lime, slaked in 2 quarts of hot water. Apply as in No. 1.

No. 5. *Bordeaux Mixture* (No. 1), with *Paris green* added at the rate of 1 ounce to 10 gallons. Apply as in No. 1.

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* The following scheme for treating crops is after a plan published by Mr. E. G. Lodeman, of Cornell University, in Trans. N. Y. State Agricultural Society for 1893, pp. 176–179.

No. 6. *London purple*, 4 ounces, very thoroughly mixed with 25 pounds of *land plaster.* Apply with a sprinkling-box.

No. 7. Mix 1 ounce of fresh powdered *white hellebore* in 3 gallons of water. Apply at once with force-pump or sprinkling pot.

No. 8. *Kerosene Emulsion.*—Dissolve ¼ pound hard, or 1 quart of soft soap in 2 quarts of boiling water; add 1 pint of kerosene and pour at once into a tin can; cork, and shake rapidly for 15 seconds. Before using, dilute with its own bulk of warm soft-water. Apply as in No. 2.

No. 9. Mix 1 pound of fresh *Pyrethrum powder* with an equal bulk of air-slaked lime in a bottle or tin can; cork tightly and leave 24 hours before use. Apply in still air, with sprinkling-box or powder-bellows.

No. 10. *Air-slaked lime* applied with the sprinkling-box.

No. 11. Cut small cards from thin tarred paper, slit one side to the centre, and make a short cross-cut near the end of the slit, as in drawing.

No. 12. *Corrosive Sublimate Solution.*—Dissolve 2¼ ounces of corrosive sublimate in 2 gallons of hot water, and pour this solution into 13 gallons of cold water. Use wood, earthen, or glass vessels.

No. 13. *Potassium Sulfid Solution.*—Dissolve ½ ounce of potassium sulfid (liver of sulfur, sulfuret of potassium) in 1 quart of warm (not hot) water, and add this solution to 3 quarts of cold water. Apply as in No. 2.

SPRAYING CALENDAR

	First Treatment.	Second Treatment.	Third Treatment.	Fourth Treatment.	Fifth Treatment.	Remarks.
Apple.	When buds begin to swell, No. 3, for scab.	When leaf-buds are expanding, No. 8, for aphis.	*Just before flowers open, No. 5, for scab, bud-moth and leaf-roller.*	*When petals have fallen, No. 5, for scab and codling-moth.*	*8 to 12 days later repeat 4th treatment for scab and codling moth.*	Should June prove rainy, use No. 1 the latter part of month. Blight should be watched for, and all affected branches promptly removed and burned.
Bean.	*When third leaf expands, No. 1, for anthracnose.*	*Repeat 1st treatment 10 days later.*	Repeat same 2 weeks after second.	Repeat same 2 weeks after third.		
Cabbage, Cauliflower.	*Keep young plants covered, as they vegetate, with No. 10, for flea-beetle;* sifted road dust or coal ashes will answer.	Use No. 11 at time of setting early plants, for root-maggot. Place closely about stem at surface of ground.	If green worms appear before heading, No. 6.	If green worms appear while heading, No. 7.		Should the aphis appear, cultivate thoroughly and apply stimulating manure.
Cherry.	When leaf-buds open, No. 8, for aphis, followed next day with No. 1, for rot.	When fruit has set, use No. 1, for rot. Should slug appear on leaves, use No. 10.	10 to 14 days later, No. 1, for rot.	10 to 14 days after 3d treatment, No. 2, for rot.		Watch branches at all times for black-knot and cut out as soon as discovered.
Currant.	*At first sign of worms, No. 4.*	10 days later, No. 7.	If worms persist, repeat 2d treatment.			Where leaves are affected with mildew, use No. 1 at time of first treatment.

SPRAYING CALENDAR.—*Continued.*

	First Treatment.	Second Treatment.	Third Treatment.	Fourth Treatment.	Fifth Treatment.	Remarks.
Egg-plant.	*Use No.* 6 *freely for potato-beetle.*	*Repeat the use of No.* 6 *as often as seems necessary.*				
Gooseberry	*When leaves expand, No.* 1, *for mildew.*	*At first signs of worms, No.* 5.	10 *to* 14 *days later, No.* 13. *Should worms persist, No.* 7.			Repeat 3d treatment as often as indications of mildew appear.
Grape.	When leaf-buds are swelling, No. 3, for fungi.	*When leaves are half-grown, No.* 1, *for fungi.*	*When flowers are open, No.* 1, *for fungi.*	10 *to* 14 *days later, repeat* 3*d treatment.*	If disease appears, repeat same.	*In wet seasons use No.* 2 ***August*** 1.
Melon. Squash, Cucumber.	*Cover hills at time of planting with tight frames covered with mosquito-netting, for striped-beetle.*	Should squash bugs appear, pick off, or trap beneath leaves.	Should squash-vine borer appear, cut out or cover joints of vines with earth.			
Nursery stock.	*When first leaves appear, No.* 1 *for fungous diseases.*	*In* 10 *to* 14 *days repeat* 1*st treatment.*	In 10 to 14 days more, repeat first treatment.	In 10 to 14 days more, repeat 1st treatment.		
Peach and Nectarine.	*Before buds swell, No.* 3, *diluting to* 25 *gallons, for rot and mildew.*	Before flowers open, No. 1, for rot and mildew.	*When fruit is well advanced, No.* 1, *for same.*	*When fruit is grown, No.* 2, *for same.*		For later varieties the 4th treatment may need to be repeated.
Pear.	As buds are swelling, No. 3, for scab and leaf-blight.	After leaves open, No. 8, for psylla.	*Just before blossoms open, No.* 1, *for scab and leaf-blight.*	*After petals have fallen, No.* 5, *for scab, leaf-blight, and codling-moth.*	After 10 or 12 days repeat 4th treatment. *Remove all branches affected with blight.*	Should June prove wet, use No. 1 once or twice during latter part of the month. *Watch for blight all summer.*

SPRAYING CALENDAR.—*Continued.*

	First Treatment.	Second Treatment.	Third Treatment.	Fourth Treatment.	Fifth Treatment.	Remarks.
Plum.	When buds are swelling, No. 3, for fungous diseases. *Remove all branches affected with black-knot.*	*When petals have fallen, No. 1, for fungous diseases. Continue the watch for black-knot.*	10 *to* 14 *days later, repeat 2d treatment. Look out for black-knot.*	After 10 to 20 days longer repeat 2d treatment.	After 10 to 20 days longer No. 2, for fungous diseases.	*Begin jarring trees for curculio when petals have fallen, and continue until no more are found.*
Potato.	*Soak seed-tubers in No.* 11 *one and a half hours, for scab.*	*When beetles appear, No.* 6.	*When plants are* 6 *inches high, No.* 5, *for beetles and blight.*	10 days later, No. 1, for blight.		*Should weather prove warm and wet, use No.* 1 *frequently until tops die, for rot.*
Quince.	When blossom-buds appear, No. 1, for leaf and fruit spot.	When fruit has set, repeat 1st treatment.	*After* 10 *to* 20 *days, repeat first treatment.*	*Repeat 1st treatment in* 10 *to* 20 *days longer.*		
Raspberry, Bl'kberry, Dewberry.	Before leaf buds open, No. 3, for anthracnose.	When leaves are well-formed, No. 1, for anthracnose.	Watch canes for symptoms of anthracnose and, if found, repeat 2d treatment.			*Remove and burn all plants affected with orange-rust as soon as observed.*
Strawberry.	Should leaf-roller appear, No. 7.	*After fruit is all gathered mow off foliage, and when dry, burn, with the mulching, for rust.*	If season is dry, apply water plentifully, for rust.			
Tomato.	Two weeks after planting out, No. 1, for rot and blight.	10 days after, repeat 1st treatment.	Repeat 1st treatment in 10 to 20 days.			Should weather be warm and wet, repeat 1st treatment often.
Turnip.	Young plants, see Cabbage.					

FIGHTING THE CHINCH-BUG BY MEANS OF KEROSENE EMULSION. (GOFF.)

Experiments have established the fact that with thorough work according to the directions given below the kerosene emulsion will prevent the invasion of cornfields by chinch-bugs, even though the bugs appear in great numbers.

How to Make and Apply the Kerosene Emulsion.—Slice half a pound of common bar soap, put it in a kettle with one gallon of soft water, and boil until dissolved ; put two gallons of kerosene in a churn or stone jar, and to it add the boiling-hot soap solution ; churn from twenty to thirty minutes, when the whole will appear creamy. If properly made, no oil will separate out when a few drops of the emulsion are placed on a piece of glass. To each gallon of the emulsion add eight gallons of water and stir. Apply with a sprinkling-pot.

Every farmer should learn to make this emulsion, as it is a most useful insecticide. It is especially valuable for killing lice on cattle and hogs. Paris green will not kill chinch-bugs.

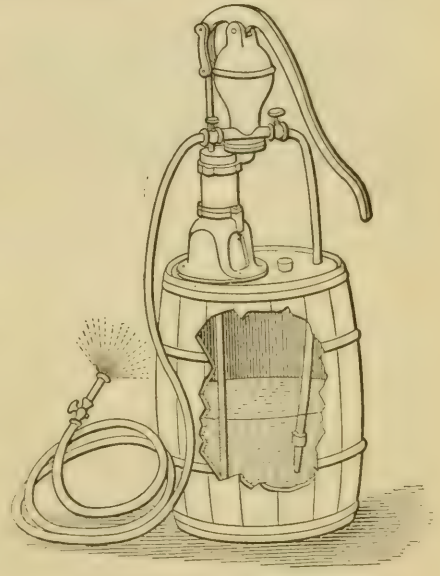
The bugs will be very likely to enter cornfields bordering grainfields, after the grain is cut. Before they have had time to do this plough a deep furrow along the side of the field they will enter, and throw into it stalks of green corn. When the bugs have accumulated on the corn, sprinkle with the emulsion. Put in fresh stalks and sprinkle whenever the bugs accumulate. If they break over the barrier, as they probably will, run a few furrows a few rows back in the field, and repeat. When they have attacked stalks of standing corn, destroy by sprinkling.

If the remedy is tried, it should be used persistently. To kill one lot of bugs and then stop will do little or no good. When the bugs threaten to destroy as much as five or ten acres, it will pay for one or two men to devote their whole time to the warfare. Only a part of each day, however, will be needed. Some corn will be lost at best but the most of the field should be saved.

A CHEAP ORCHARD-SPRAYING OUTFIT.

(U. S. Dept. of Agriculture.)

Spraying to control various insect pests, particularly those of the orchard and garden, has reached so satisfactory and inexpensive a basis that it is recognized by every progressive farmer as a necessary feature of the year's operations, and in the case of the apple, pear, and plum crops the omission of such treatment means serious loss. The consequent demand for spraying apparatus has been met by all the leading pump manufacturers of this country, and ready-fitted apparatus, consisting of pump, spray tank or barrel, and nozzle with hose, are on the market in numerous styles and at prices ranging from $20 upward. The cost of a spraying outfit for orchard work may, however, be considerably reduced by purchasing merely the pump and fixtures, and mounting them at home on a strong barrel. An apparatus of this sort, representing a style that has proven very satisfactory in practical experience, is illustrated in the accompanying figure. It is merely a strong pump with an air-chamber to give a steady stream, provided with two discharge hose-pipes. One of these enters the barrel and keeps the water agitated and the poison thoroughly intermixed, and the other and longer one is the spraying hose and terminates in the nozzle. The spraying-hose should be about 20 feet long, and may be fastened to a light pole, preferably of bamboo, to assist in



Orchard-spraying Apparatus.

directing the spray. The nozzle should be capable of breaking the water up into a fine mist spray, so as to wet the plant completely with the least possible expenditure of liquid. The two more satisfactory nozzles are those of the Nixon and the Vermorel type. A suitable pump with nozzle and hose may be obtained of any pump manufacturer or hardware dealer at a cost of from $13 to $15. If one with brass fittings be secured it will also serve for the application of fungicides. The outfit outlined above may be mounted on a cart or wagon, the additional elevation secured in this way facilitating the spraying of trees, or for more extended operations, the pump may be mounted on a large water tank.

IX. FORESTRY.

FORESTRY FOR FARMERS.

By B. E. Fernow, Chief Division of Forestry, U. S. Department of Agriculture.

There has been much talk about forestry, but there has been little application of the teachings of that science. This is easily explained as far as the lumbermen are concerned, who are in the business of making money by cutting the virgin woods, similar to the mining of ore, but it is less intelligible with the farmer, who is presumed to be in the business of making money by the production and harvesting of crops, which he grows on the soil of his farm.

That his wood-lot could and should by him be also treated as a crop seems rarely to have entered his mind. Whether he starts out, as in the prairie portions of the State, by planting a grove, or whether he cuts his wood from the virgin growth which he left after clearing enough for field and meadow, in either case he should fully realize that he is dealing with a valuable crop, which requires and will pay for the attention and application of knowledge in its management, such as a husbandman will give to it.

The Wisconsin farmer, just as his neighbor in Minnesota, living in a State largely covered with timber of great value, has special reason to practise the principles of forestry in order to get the most out of this part of the property both for the present and the future. And those who are located in the prairie portions have no less need of maintaining a forest growth on some part of their farm as a matter of proper management of their resources.

The first thing, as with every other crop, that will have to be decided is on what portions of the farm this wood-crop is best propagated. In deciding about the location of the wood-lot the farmer must keep in mind:

1. That wood will grow on almost any soil, which is unfit for agricultural use; that, although it grows best on the

best sites, it is to be mainly considered and used as a "stop-gap" to make useful those parts which would otherwise be waste.

2. That a forest growth, besides furnishing useful material, is a condition of soil-cover which affects other conditions, namely, of climate and water-flow, and hence its location should be such as to secure the most favorable influence on these.

3. That the wood-crop does not live on the soil, but on the air, enriching the soil in nutritive elements by its decaying foliage rather than exhausting it, and hence that no manuring and no rotation of crops is necessary as in field crops; in other words, the location of the wood-crop can be made permanent.

A wood growth should therefore be maintained on the farm :

a. Wherever the ground is too wet or too dry, too thin or too rocky or too steep, for comfortable ploughing and for farm crops to do well, or for pasturage to last long, or, in general, where the ground is unfit for field and meadow.

b. On the highest portions of the farm, the tops of hills and also in belts along the hillsides, so as to interrupt continuous slopes, which might give rise to such a rush of surface-waters as to gully the ground and make it unfit for field crops or pasture ; the gentler slopes which are liable to washing should at least be kept in grass or terraced for crops to prevent the rush of surface-waters.

c. Along watercourses, where narrower or wider belts of timber should be maintained to prevent undermining of banks and washing of soil into the streams if ploughed too close to the border ; the shade of a forest growth would also check rapid evaporation of smaller watercourses.

d. Wherever the protection by a wind-break against cold or hot winds is desirable, for which purpose the timber belt is of more far-reaching effect than the wind-break of a single row of trees ; the reduced evaporation from the fields due to this protection has been known to increase the yield of field crops by as much as 25 per cent.

e. On all unsightly places, which impair the general

aspect of the farm—and there are few farms without these—a few trees, a small grove, will add to the thrifty appearance of the farm, make useful the otherwise waste spots, and serve as shelter to grazing cattle, etc.

Altogether, the farmer should realize that husbandry of soil and water is the secret of future success, and that successful water management is best attained by the maintenance of properly located and well-managed forest areas.

There is much extravagant talk about the influence of forests on climate and on rainfall especially. We have but little definite knowledge on these subjects, but it takes no expert, only a little observation, to appreciate the effects of a wind-breaking timber belt on one's own feeling, and it takes but little reasoning to appreciate that the field crop in the shelter of the timber belt participates in this feeling. The dry winds are the great bane of field crops in the West, because they dissipate the moisture ; a timber belt breaks their force and reduces thereby their evaporating power.

Just so it takes no great philosopher to see that when rain falls on naked ground it compacts that ground and by and by prevents itself from penetrating; the water is forced to drain up superficially and rapidly, instead of sinking into the ground and remaining there for the use of field crops. And that the washing and gullying of the soil is also a result of this rushing off of surface-waters, due to the clearing away of its plant-cover, requires no wise man to point out ; every farmer experiences it more or less every year.

That any one farmer's neglect or the devastation of any small part of the forest growth should have an influence on the rainfall or climate of the whole country nobody should claim; but the conditions surrounding each particular farm, its local climate, soil, and water conditions, are changed, and finally the aggregate changes make themselves felt over the whole state.

Now as to the management of the wood-lot a few hints may be acceptable. The farmer may not necessarily employ the finer methods of managing the wood-crop, but by the mere application of common sense and a little knowledge of tree-life he may do better than he does at present.

He should at least observe the following rules:

1. Fire should be carefully kept out of the wood-lot, for it has in no way a beneficial effect. It kills not only the undergrowth, which is desirable because it helps to shade the soil, and injures, if it does not kill, the young tree growth, which is to take the place of the older growth, but the worst effect is that it consumes the vegetable mould which has accumulated by the fall and decay of leaves, twigs, and other vegetation, and which forms the manure, the fertility, of the soil. Fire is to be used only when through bad management or otherwise a dense undesirable undergrowth has come in, which it is too expensive to remove in other ways when the time for natural reproduction has come or planting is to be done. It must then be used with caution in early spring or late fall, before the brush is too dry, when the fire will smoulder rather than burn fiercely and can be kept within bounds.

2. Cattle must be kept out where young forest growth is to be fostered. Sheep and goats especially are of no benefit to wood-crops, but horses and cattle may be allowed to browse through the wood-lot where the young growth has passed out of their reach. Pigs are a benefit by working over the ground and thereby burying seeds, especially acorns; but after the seed is so brought under ground where a young crop is expected to be reared next year they must be kept out. Altogether, the cattle and farm animals should be kept where you want them, and not where you do not want them. Sometimes, however, the roaming of cattle may be beneficial by keeping down too dense impenetrable underbrush in young sapling growth.

It is better to so cut and manage the old timber that a desirable new growth will spring up than to cut clean and replant. Planting should be done only where there is no desirable natural tree growth. Hence where there is a well-established wood-lot, the whole management of the crop consists in proper cutting.

How this is best done cannot be described readily within the short space of this article, but every farmer who is interested in learning the principles of using the axe to

advantage in reproducing a wood crop or how to establish a wood-lot can obtain from the U. S. Department of Agriculture, free of charge, a pamphlet entitled "Forestry for Farmers," in which in plain language is discussed in detail how trees and forests grow, how to start a wood-crop, and how to manage the wood-lot.

It does not exhaust the subject, but merely teaches the first steps, and the thinking farmer will find his way of stepping farther.

NUMBER OF TREES ON AN ACRE. (Egleston.)

The number of trees needed to plant an acre of ground, at various distances apart, is as follows:

2 ft. apart each way	10,890	12 ft. apart each way...	302
3 " by 2 ft.........	7,260	15 " " " " ...	200
3 " apart each way	4,840	18 " " " " ...	135
4 " " " "	2,722	20 " " " " ...	110
5 " " " "	1,742	22 " " " " ...	90
6 " " " "	1,210	25 " " " " ...	70
8 " " " "	680	30 " " " " ...	50
10 " " " "	435		

Rows six feet apart, and trees one foot apart in the row, 7260 trees per acre.

Rows eight feet apart, and one foot apart in the row, 5445 trees per acre.

Rows ten feet apart, and one foot apart in the row, 4356 trees per acre.

One mile of wind-breaks or shelter-belt requires 528c trees, or cuttings for a single row one foot apart in the row.

FUEL VALUE AND SPECIFIC GRAVITY OF SOME OF THE MORE IMPORTANT WOODS OF THE UNITED STATES. (SARGENT.)

NOTE.—The term *Atlantic* indicates the region east of the eastern base of the Rocky Mountains; the term *Pacific*, the region west of that line.

No.	Common Name.	Botanical Name.	Region.	Fuel Value. Per Cubic Decimeter.	Fuel Value. Per Kilogram.	Order by Weight.	Specific Gravity.	Weight per Cubic Foot. lbs.
1	Mountain Mahogany	Cercocarpus ledifolius	Interior Pacific	4,234.06	4,052.90	34	1.0447	65.10
2	Southern or Long-leaved Pine	Pinus australis	South Atlantic Coast.	4,113.33	5,545.82	1	0.7417	46.22
3	Shellbark or Shagbark Hickory	Carya alba	Atlantic	3,851.17	4,078.76	28	0.9442	58.84
4	Chestnut Oak	Quercus Prinus	"	3,843.69	3,997.32	38	0.7114	44.32
5	Pitch Pine	Pinus rigida	Atlantic Coast	3,472.26	5,491.47	2	0.6323	39.40
6	Pignut Hickory	Carya porcina	Atlantic	3,392.12	3,922.89	43	0.8647	53.88
7	White Hickory	Carya tomentosa	"	3,380.57	3,904.11	45	0.8659	53.96
8	Pitch-pine	Pinus Cubensis	South Atlantic Coast.	3,363.40	4,418.55	8	0.7612	47.44
9	Mesquite	Prosopis juliflora	Texas to California	3,291.21	4,352.30	11	0.7562	47.12
10	Overcup Oak	Quercus lyrata	Southern Atlantic	3,268.92	4,102.65	25	0.7962	49.61
11	White Elm	Ulmus Americana	Atlantic	3,247.02	4,191.87	19	0.7746	48.27
12	White Oak	Quercus alba	"	3,197.41	4,187.83	21	0.7635	46.58
13	Spanish Oak	Quercus falcata	Southern Atlantic.	3,193.28	4,055.48	33	0.7874	49.07
14	Cedar	Juniperus occidentalis, var. monosperma	Pacific	3,143.57	4,587.81	6	0.6852	42.70
15	Bitter Pecan	Carya aquatica	Southern Atlantic	3,140.33	4,073.59	30	0.7709	48.04
16	Yellow Pine	Pinus mitis	" "	3,091.82	5,062.75	3	0.6107	38.06
17	Sugar Maple	Acer saccharinum	Atlantic	3,091.37	4,345.48	12	0.7114	44.32
18	Red Oak	Quercus rubra	"	3,062.08	4,075.16	29	0.7514	46.72
19	Persimmon	Diospyros Virginiana	"	2,970.45	3,781.61	50	0.7855	48.95
20	Larch or Tamarack	Larix Americana	Northern Atlantic.	2,937.46	4,182.04	22	0.7024	43.77

21	Butternut Hickory	Carya amara	Atlantic	2,863.42	3,903.25	46	0.7336	45.71
22	Locust	Robinia Pseudacacia	Alleghany Mountains	2,822.99	3,890.02	48	0.7257	45.22
23	Beech	Fagus ferruginea	Atlantic	2,795.34	3,895.04	47	0.7175	44.71
24	Pecan	Carya olivæformis	Southern Atlantic	2,768.72	3,954.75	41	0.7001	43.63
25	Black-jack	Quercus nigra	" "	2,692.51	3,713.81	54	0.7250	45.18
26	Water-Oak	Quercus aquatica	" "	2,655.82	3,718.07	53	0.7143	44.51
27	White Ash	Fraxinus Americana	Atlantic	2,652.34	4,217.42	17	0.6289	39.19
28	Black Oak	Quercus tinctoria	"	2,595.04	3,774.60	51	0.6875	43.84
29	White Oak	Quercus Garryana	North Pacific Coast	2,594.31	3,667.39	55	0.7074	44.08
30	Canoe Birch	Betula papyracea	Northern Atlantic	2,582.66	4,101.41	26	0.6297	39.24
31	White or Gray Birch	Betula alba, v. populifolia	North Atlantic Coast	2,509.00	4,073.05	31	0.6160	38.05
32	Yellow Pine	Pinus ponderosa	Pacific	2,441.24	4,600.04	5	0.5307	33.07
33	Sycamore	Platanus occidentalis	Atlantic	2,406.89	4,071.83	32	0.5911	36.83
34	Nut-pine	Pinus monophylla	Interior Pacific	2,270.77	4,149.04	23	0.5473	34.11
35	Sweet or Red Gum	Liquidambar Styraciflua	Atlantic	2,255.24	4,016.46	37	0.5615	34.99
36	Scrub or Gray Pine	Pinus Banksiana	Northern Atlantic	2,152.66	4,393.18	9	0.4900	30.54
37	Black Pine	Pinus pungens	Alleghany Mountains	2,054.78	3,995.30	39	0.5143	32.05
38	Red or Norway Pine	Pinus resinosa	Northern Atlantic	2,051.75	4,226.05	16	0.4855	30.26
39	Old Field or Loblolly Pine	Pinus Tæda	Southern Atlantic	2,031.75	4,087.20	27	0.4971	30.98
40	Jersey or Scrub Pine	Pinus inops	Atlantic	2,008.20	4,126.15	24	0.4867	30.33
41	Redwood	Sequoia sempervirens	California Coast	1,985.50	4,191.47	20	0.4737	29.52
42	Black Walnut	Juglans nigra	Atlantic	1,984.56	3,857.26	49	0.5145	32.06
43	Cypress	Taxodium distichum	So. Atlantic	1,921.63	4,705.27	4	0.4084	24.45
44	Cottonwood	Popolus monilifera	Atlantic	1,906.42	4,242.15	15	0.4494	28.00
45	Chestnut	Castanea vulgaris, var. Americana	Atlantic	1,868.25	4,042.96	35	0.4621	28.80
46	Digger or Bull Pine	Pinus sabiniana	California	1,804.29	3,982.97	40	0.4530	28.28
47	Tamarack	Pinus contorta, var. Murrayana	Pacific	1,791.33	4,019.13	36	0.4457	27.78
48	Sugar-pine	Pinus Lambertiana	California	1,785.40	4,419.31	7	0.4040	25.18
49	Red or Yellow Fir	Pseudotsuga Douglasii	Pacific	1,766.32	4,354.84	10	0.4056	25.28
50	Hemlock	Tsuga Canadensis	Northern Atlantic	1,724.26	4,208.58	18	0.4097	25.53
51	Aspen	Populus tremuloides	Atlantic and Pacific	1,624.64	4,292.31	13	0.3785	23.59
52	Black Spruce	Picea nigra	Northern Atlantic	1,614.11	3,949.37	42	0.4087	25.47
53	White Pine	Pinus strobus	" "	1,489.03	4,272.69	14	0.3485	21.72
54	Yel. Poplar or Tulip Tree	Liriodendron tulipifera	Atlantic	1,425.57	3,744.61	52	0.3807	23.72
55	Yellow or White Cedar	Thuga occidentalis	Northern Atlantic	1,411.57	3,917.77	44	0.3603	22 45

DISTANCE TABLE FOR TREE-PLANTING. (Yearbook U. S. Dept. of Agriculture.)

Number of Trees that may be Set upon a Piece of Land 100 Yards or Feet Square on a Side in Right-angled Rows at Equal or Unequal Distances Apart.

Yards or Feet between Trees in the Rows.	Yards or Feet between Rows.														
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0	10.0
.5	20,000	13,333	10,000	8,000	6,667	5,714	5,000	4,444	4,000	3,636	3,333	2,857	2,500	2,222	2,000
1.0	10,000	6,667	5,000	4,000	3·333	2,857	2,500	2,222	2,000	1,818	1,666	1,428	1,250	1,111	1,000
1.5	6,667	4,444	3,333	2,667	2,222	1,905	1,667	1,481	1,333	1,212	1,111	952	833	740	666
2.0	5,000	3,333	2,500	2.000	1,667	1,429	1,250	1,111	1,000	909	833	714	625	555	500
2.5	4,000	2,667	2,000	1,600	1,333	1,143	1,000	889	800	727	666	571	500	444	400
3.0	3,333	2,222	1,667	1,333	1,111	952	833	741	667	606	555	476	416	370	333
3.5	2,857	1,905	1,429	1,143	952	816	714	635	571	519	476	408	357	317	285
4.0	2,500	1,667	1,250	1,000	833	714	625	556	500	455	416	357	312	277	250
4.5	2,222	1,481	1,111	889	741	635	556	494	444	404	370	317	277	246	222
5.0	2,000	1,333	1,000	800	667	571	500	444	400	364	333	285	250	222	200
5.5	1,818	1,212	909	727	606	519	455	404	364	333	303	259	227	202	181
6.0	1,667	1,111	833	667	556	476	417	370	333	303	277	238	208	185	166
6.5	1,538	1,026	769	615	513	440	385	342	308	280	256	219	192	170	153
7.0	1,429	952	714	571	476	408	357	317	286	260	238	204	178	158	142
7.5	1,333	889	667	533	444	381	333	296	267	242	222	190	166	148	133
8.0	1,250	833	625	500	417	357	313	278	250	227	208	178	156	138	125
8.5	1,176	784	588	471	392	336	294	261	235	219	196	168	147	130	117
9.0	1,111	741	556	494	370	317	278	247	222	202	185	158	138	123	111
10.0	1,000	667	500	400	333	286	250	222	200	182	166	142	125	111	100

In order to find number of trees needed per acre, divide the above figures by 2 if they have been read as referring to feet; multiply them by $4\frac{1}{2}$ if they have been read as referring to yards. This will give the number within an unappreciable error.

STATES AND TERRITORIES OBSERVING ARBOR DAY, WITH DATES. (U. S. Department of Agriculture.)

States.	Year of First Observance.	Time of Observance.
Alabama	1887	22d of February.
Arizona	1890–91	First Friday after 1st of February.
Arkansas		
California	1886	
Colorado	1885	Third Friday in April.
Connecticut	1887	In spring, at appointment of governor.
Florida	1886	January 8.
Georgia	1887	First Friday in December.
Idaho	1886	Last Monday in April.
Illinois	1888	Date fixed by governor and superintendent of public instruction.
Indiana	1884	Date fixed by superintendent of public instruction.
Iowa	1887	Do.
Kansas	1875	Option of governor, usually in April.
Kentucky	1886	Do.
Louisiana	1888–89	Option of parish boards.
Maine	1887	Option of governor.
Maryland	1889	Option of governor, in April.
Massachusetts	1886	Last Saturday in April.
Michigan	1885	Option of governor.
Minnesota	1876	Do.
Mississippi	1892	Option of board of education.
Missouri	1886	First Friday after first Tuesday in April.
Montana	1887	Third Tuesday of April.
Nebraska	1872	22d of April.
Nevada	1887	Option of governor.
New Hampshire	1886	Do.
New Jersey	1884	Option of governor, in April.
New Mexico	1890	Second Friday in March.
New York	1889	First Friday after May 1.
North Carolina	1893	
North Dakota	1884	6th of May, by proclamation of governor.
Ohio	1882	In April, by proclamation of governor.
Oklahoma	....	
Oregon	1889	Second Friday in April.
Pennsylvania	1887	Option of governor.
Rhode Island	1887	Do.
South Carolina	Uncertain.	Variable.
South Dakota	1884	Option of governor.
Tennessee	1875	November, at designation of county superintendents.
Texas	1890	22d of February.
Vermont	1885	Option of governor.
Virginia	1892	
West Virginia	1883	Fall and spring, at designation of superintendent of schools.
Wisconsin	1889	Option of governor.
Wyoming	1888	Do.
Washington	1892	Do.

FOREST-FIRE LAWS IN THE UNITED STATES.

(FERNOW.)

(See p. 106 for penalties imposed.)

State.	Edition of Code.	Title.	Chapter.	Section.
Alabama	C. C. 1886			4226–8
Arkansas[1]	S. & H.'s D. 1894		48	1580–4
California[2]	P. C. 1886	10		384
Colorado	Mills, G. S. 1891		36	1414–15, 17–18
Connecticut[3]	G. S. 1888	19	99	1458, 1460–2
Delaware[4]	Vol. XVIII		93	1–2
Florida	Laws 1879			3141
Georgia[5]	1882		10	1456–9
Idaho	R. S. 1887	9		6921
Illinois	R. S. 1895		38	18
Indiana	R. S. 1894		5	2001
Iowa	McLean's, 1888	24	3	5185–92
Kansas	C. L. 1889			7276–8
Kentucky	G. S. 1888		29	5–6
Louisiana	1884			817
Maine	Laws 1891		100	5
Maryland.[6]				
Massachusetts[7]	Sup. 1888		163	1–2
Michigan[8]	Howell's A. S. 1882		328	9402–4
Minnesota[9]	G. S. 1878		95	6
Mississippi	1892		29	1091
Missouri	R. S. 1889		47	3613

[1] S. 1847: Burning off permitted when consent of neighbors is secured after 1 day's notice.

[2] Pol. Code, S. 3344–5: Persons firing woods, etc., liable in treble damages. Constable, etc., may order any inhabitants liable to poll-tax to assist in extinguishing fire.

[3] Must give notice, before burning off, to all residents within one mile, and can only be done between February 15 and March 31, unless otherwise ordered by county commissioner.

[4] Prohibits building fire in woods without owner's permission, and without first clearing away combustibles, and extinguishing fire.

[5] Must give 1 day's notice, before burning off, to adjoining property owners, and then only betwen Feb. 20 and April 1.

[6] No law included in Revised Statutes.

[7] Ch. 296, S. 1–6, G. S. 1883: Duty of fire wardens to post warnings, extinguish fires, and investigate causes of fires.

[8] Supervisors and highway commissioners to order assistance in putting out fires; fine \$5–\$50 for refusal to assist.

[9] See act of April 18, 1895.

FOREST-FIRE LAWS—*Continued.*

State.	Edition of Code.	Title.	Chapter.	Section.
Montana[10]	P. C. 1895			1071-2
Nebraska	1895		c. c. 9-62	6713
Nevada	G. S. 1885			4794
New Hampshire	P. S. 1891		277	3-7
New Jersey[11]	R. S. 1877	Fire.		1 and supplements.
New York	R. S.	14	20	....
North Carolina[12]	Vol. I. 1883		7	52-4
North Dakota	1895		P. C. 40	7314-15
Ohio[13]	R. S. 1894			6334
Oregon[14]	Sess. 1893			Page 45
Pennsylvania	1894			Act of June 11, 1879-81
Rhode Island	G. S. 1886		279	6
South Carolina[15]	1893	Crim. Stat.	101	151-7
South Dakota	Dak. Ter.			2398
Tennessee[16]	M. & V. C. 1884			2277-8
Texas	P. C. 1889	17	2	669-70
Utah[17]	C. L. 1888	10		4576
Vermont	1894	32	213	4934
Virginia	1887		181	3701-2
West Virginia	1891		2	81-84
Wisconsin	R. S. 1889			4406
Wyoming[18]	R. S. 1887			920-2
Arizona	R. S. 1887			608-9
New Mexico	1884			2313-14
Oklahoma[19]	1893		25 37 entire.	2269-70

10 Penalty for failing to extinguish camp-fire or malicious firing of woods, fine not exceeding $5000, or imprisonment not exceeding 5 years, or both.

11 Ch. 188, G. P. Laws 1888, provides detectives for violators of fire law. Ch. 119, Laws 1892, and Ch. 194, Laws 1894, provide for fire marshals and define their duties.

12 Fine $10 for leaving unextinguished camp-fire. Two days' notice in writing before firing one's own woods.

13 S. 4750-1: Penalty for refusing to assist in extinguishing fires, fine $10.

14 Requires governor to issue proclamation annually July 1, warning people against forest fires.

15 If turpentine farm, fine $500, or penitentiary 1 year.

16 Owner may fire his own woods after two days' notice to neighbors.

17 Ch. 27, Laws 1892: Duty of county sheriffs to extinguish fires.

18 Permits firing grass and sage-bush March, April, and October, if kept within control.

19 Camp-fires, and regulations for burning off prairies, etc., Ch. 37 (enacted 1890) provides penalties for setting fires and failure to extinguish.

FOREST-FIRE LAWS—*Continued.*

PENALTY PRESCRIBED BY STATE LAWS.

Alabama.—Fine $10–$200; if turpentine forest, $100–$1000, or hard labor for not more than 12 months.

Arkansas.—Fine $25-$300, or jail 10-60 days. Liable for double damages.

California.—Fine not more than $1000, or jail not more than 1 year, or both.

Colorado.—Fine $50–$300, or jail 15 days to 3 months, or both If on State lands, $50–$500, or jail 20 days to 6 months.

Connecticut.—Fine $20-$200, or jail 2-6 months, or both. Fine $1–$50, or jail not more than 30 days.

Delaware.—Fine $25.

Florida.—Fine not more than $100, or jail not more than 60 days.

Georgia.—Fine not more than $1000, or 1 year in chain-gang, or both.

Idaho.—Misdemeanor.

Illinois.—Fine $5–$100.

Indiana.—Fine $5–$100, to which may be added imprisonment not more than 30 days.

Iowa.—Fine not exceeding $500, or jail not exceeding 1 year.

Kansas.—Fine $50–$500, or jail 10 days to 6 months, or both.

Kentucky.—Fine $100, or in discretion of jury.

Louisiana.—Fine $5–$500.

Maine.—Fine not exceeding $100, or jail not exceeding 30 days, or both.

Massachusetts.—Fine not more than $100, or jail not more than 6 months.

Michigan.—Fine not more than $100, or jail not more than 1 year, or both.

Minnesota.—State prison 6 months to 2 years.

Mississippi.—Fine $20–$500, or jail not more than 3 months, or both.

Missouri—Fine not more than $500, or jail not more than 12 months.

Montana.—Fine not more than $1000, or jail not more than 1 year.

Nebraska.—Fine $5–$100, and jail 1–6 months.

Nevada.—Fine $200–$1000, or jail 10 days to 6 months, or both.

New Hampshire.—Fine $10–$2000, or imprisonment not more than 3 years.

New Jersey.—Fine not more than $100, or jail not more than 1 year, or both.

New York.—Fine not exceeding $1000, or imprisonment not exceeding 1 year.

North Carolina—Fine $50.

North Dakota.—Wilful, a misdemeanor; negligent, fine $10–$100.

Ohio.—Fine not more than $100, or jail not more than 20 days, or both.

Oregon.—Fine $10–$1000, and in certain cases penitentiary not exceeding 1 year.

Pennsylvania.—Fine not more than $300, or jail not more than 1 year, or both.

Rhode Island.—Imprisonment not exceeding 2 years.

South Carolina.—Fine $5-$100, or jail not more than 30 days.

South Dakota.—Fine not more than $200, or jail not more than 1 year, or both.

Tennessee.—Forfeit $100 to prosecutor and fine $5-$50 (S. 2277, Code Sup. 1893).

Texas.—Fine $50-300.

Utah.—Misdemeanor.

Vermont.—Fine not more than $500, or penitentiary not more than 5 years.

Virginia.—Fine $5-$100, and jail 1-6 months.

West Virginia.—Fine $10-$1000, or jail not more than 12 months.

Wisconsin.—Fine not more than $500, or jail not more than 1 year.

Wyoming.—Fine not more than $500, or jail 30 days to 6 months.

Arizona.—Misdemeanor. If on State or U. S. lands, fine not more than $1000, or jail not more than 1 year, or both.

New Mexico.—Fine $60-$500.

Oklahoma.—Fine $10-$500, or jail not more than 1 year, or both.

X. MANURES AND FERTILIZERS.

It is a matter of common experience among farmers that the soil is impoverished by continuous cropping, and the yields obtained therefore gradually decreased. The decrease in yields can only be prevented by applications of farmyard manure or commercial fertilizers; ploughing and thorough cultivation of the soil bring the land in a better mechanical condition and increase the amount of available plant food present in the soil, but these operations are not sufficient to maintain the fertility of the land so that it will yield equally well from year to year under otherwise favorable conditions. Every crop harvested contains certain quantities of fertilizing ingredients, and taking away these amounts in general leaves the soil in a poorer condition for the production of crops than it was before.

The fertilizing ingredients of which the soil is thus liable to be robbed are potash, phosphoric acid, nitrogen, and sometimes lime. They are not present as such in the soil, or in the fertilizers applied to the soil, but in chemical combinations with a large variety of compounds. The soil will contain nearly all the different elements which chemists have so far succeeded in isolating, but it is mainly the three elements, potassium, phosphorus, and nitrogen, which are apt to be decreased in the soil below the amounts required for the nutrition of crops, or at least of maximum crops. In rational fertilization the effort therefore always is to return to the soil such quantities of fertilizing ingredients, in the shape of farmyard manure or commercial fertilizers, as will restore the loss sustained by the withdrawal of the crops harvested. Other mineral ingredients contained in the crops need not generally be returned to the soil, since they are nearly everywhere present in abundance.

It is the grand work done for the farmer by agricultural chemistry during the past half century which has explained the causes of the decreased fertility of land due to continuous cropping, and has given the remedies for maintaining the fertility. The latter are as follows:

First, by selling only such products from the farm as will deprive the soil of the smallest quantities of fertilizing ingredients, i.e., manufactured products, like milk, cream, butter, meat, eggs, rather than grain crops, hay, etc. The tables given on pp. 111–114 show the amounts of fertilizing ingredients removed in farm products of various kinds and deserve a close study by all farmers.

Secondly, by carefully saving the manure produced by stock—both liquid and solid (the former by the use of absorbents, peat, land plaster, kainit, superphosphate, shavings, etc., or by building special cisterns for storing it; the latter by placing it under shelter, guarding against leakage) —and returning it to the land; as the products sold off the land also contain certain quantities of fertilizing constituents, the loss must be repaired by purchase of concentrated food stuffs, at least three fourths of whose valuable ash ingredients will go into the manure and thus be saved for crops.

Thirdly, by following a rational system of rotation of crops, and by frequent culture of leguminous crops,—clovers, peas, beans, etc.,—since these are able to so fix the free nitrogen of the air as to render it of value to animals and plants.

VALUATION OF MANURES AND FERTILIZERS.

The valuation of fertilizing ingredients shown below (see p. 122) is the one agreed upon by a number of Eastern experiment and fertilizer control stations after a careful study of the retail prices of crude products of fertilizers during the six months prior to March 1, 1896. It expresses the commercial value of the fertilizers, and not their agricultural value, which will vary according to the requirements of the land and the character of the crops grown. Fertilizers are sold in States having fertilizer control, on the basis of a guarantee of a minimum content of potash,

phosphoric acid, and nitrogen, singly or combined, and it is the office of the fertilizer control stations to watch that goods offered for sale in their respective states are up to the guarantee. Farmers living in states where fertilizer laws are enacted (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Wisconsin) should not buy fertilizers except on guarantee, and should examine the fertilizer bulletins published by their respective stations to ascertain that the goods put on the market are not below the guarantee, and that the valuation price is not below the selling price of the article. Where a reasonable suspicion of fraud exists, apply to the director of the experiment station for information concerning the goods offered for sale or the firm placing them on the market.

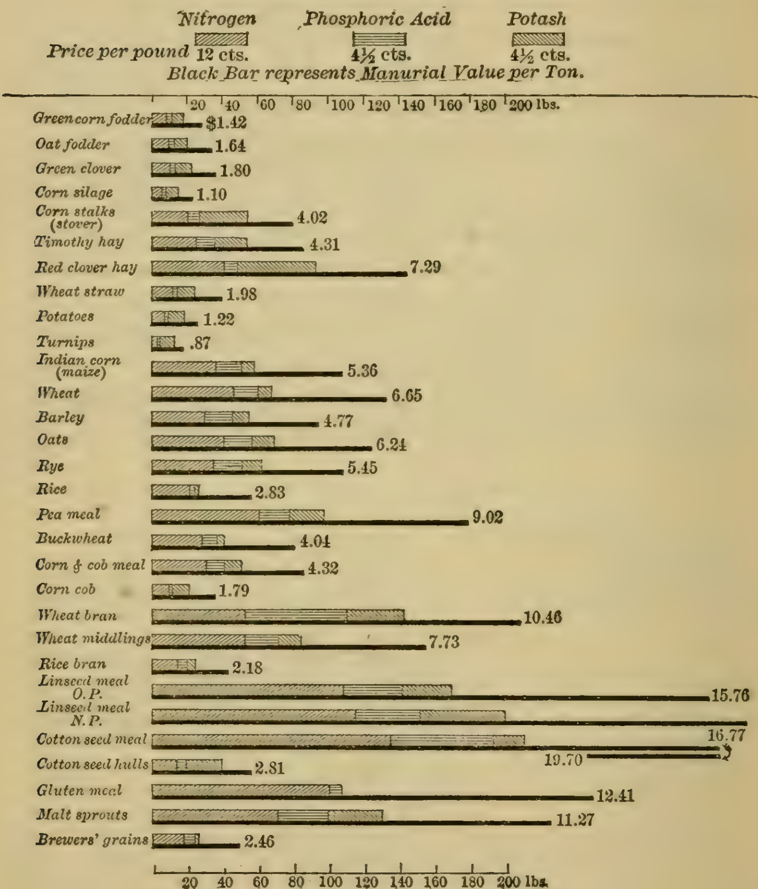
FERTILIZING CONSTITUENTS OF FEEDING STUFFS AND FARM PRODUCTS.

(Yearbook U. S. Dept. of Agriculture.)

Material.	Water.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.
Green Fodders.	per ct.	per ct.	per ct.	per ct.	per ct.
Pasture grass	63.1	3.27	.91	.23	.75
Green fodder corn	78.6	4.84	.41	.15	.33
Sorghum fodder	82.2	....	.23	.09	.23
Rye fodder	62.1	....	.33	.15	.73
Oat fodder	83.4	1.31	.49	.13	.38
Timothy grass	66.9	2.15	.48	.26	.76
Red clover	80.0	....	.53	.13	.46
White clover	81.0	....	.56	.20	.24
Alsike clover	81.8	1.47	.44	.11	.20
Scarlet clover	82.5	....	.43	.13	.49
Alfalfa (lucern)	75.3	2.25	.72	.13	.56
Cowpea	78.8	1.47	.27	.10	.31
Soja bean	73.2	....	.29	.15	.53
Prickly comfrey	84.4	2.45	.42	.11	.75
Corn silage	78.0	....	.28	.11	.37
Hay and Dry Coarse Fodders.					
Fodder corn (with ears)	7.85	4.91	1.76	.54	.89
Corn stover (without ears)	9.12	3.74	1.04	.29	1.40
Hungarian grass	7.69	6.18	1.20	.35	1.30
Common millet	9.75	....	1.28	.49	1.69
Hay of mixed grasses	11.99	6.34	1.41	.27	1.55
Red-top	7.71	4.59	1.15	.36	1.02
Timothy	7.52	4.93	1.26	.53	.90
Red clover	11.33	6.93	2.07	.38	2.20
Mammoth red clover	11.41	8.72	2.23	.55	1.22
White clover	....	....	2.75	.52	1.81
Scarlet clover	18.30	7.70	2.05	.40	1.31
Alsike clover	9.94	11.11	2.34	.67	2.23
Alfalfa	6.55	7.07	2.19	.51	1.68
Barley straw	11.44	5.30	1.31	.30	2.09
" chaff	13.08	....	1.01	.27	.99
Wheat straw	12.56	3.81	.59	.12	.51
" chaff	8.05	7.18	.79	.70	.42
Rye straw	7.61	3.25	.46	.28	.79
Oat "	9.09	4.76	.62	.20	1.24
Buckwheat hulls	11.90	....	.49	.07	.52
Roots, Bulbs, Tubers, etc.					
Potatoes	79.24	.89	.32	.12	.46
Sweet potatoes	71.26	1.00	.24	.08	.37
Red beets	87.73	1.13	.24	.09	.44
Yellow fodder beets	90.60	.95	.19	.09	.46
Sugar beets	86.95	1.04	.22	.10	.48
Mangel-wurzels	87.29	1.22	.19	.09	.38
Turnips	89.49	1.01	.18	.10	.39
Rutabagas	89.13	1.06	.19	.12	.49
Carrots	89.79	1.22	.15	.09	.51

MANURIAL VALUE OF FEEDING STUFFS.

Chart showing Pounds of Fertilizing Constituents of Feeding Stuffs in one Ton, and the Manurial Value of Feeding Stuffs, according to the Valuation given.



FERTILIZING CONSTITUENTS OF FEEDING STUFFS AND FARM PRODUCTS.—*(Continued.)*

Material.	Water.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.
Grains and Other Seeds.	per ct.	per ct.	per ct.	per ct.	per ct.
Corn	10.88	1.53	1.82	.70	.40
Sorghum seed	14.00	. ..	1.48	.81	.42
Barley	14.30	2.48	1.51	.79	.48
Oats	18.17	2.98	2.06	.82	.62
Wheat, spring	14.35	1.57	2.36	.70	.39
" winter	14.75	....	2.36	.89	.61
Rye	14.90	....	1.76	.82	.54
Millet, common	12.68	....	2.04	.85	.36
Japanese millet	13.68	....	1.73	.69	.38
Rice	12.60	.82	1.08	.18	.09
Buckwheat	14.10	....	1.44	.44	.21
Soja beans	18.33	4.99	5.30	1.87	1.09
Other Concentrated Feeds.					
Corn meal	12.95	1.41	1.58	.63	.40
Corn and cob meal	8.96	....	1.41	.57	.47
Ground oats	11.17	3.37	1.86	.77	.59
" barley	13.43	2.06	1.55	.66	.34
Wheat flour	9.83	1.22	2.21	.57	.54
Pea meal	8.85	2.68	3.08	.82	.99
Corn cobs	12.09	.82	.50	.06	.60
Hominy feed	8.93	2.21	1.63	.98	.49
Gluten meal	8.59	.73	5.03	.33	.05
Starch feed (glucose refuse)	8.10	....	2.62	.29	.15
Malt sprouts	18.38	12.48	3.55	1.43	1.63
Brewers' grains, dry	9.14	3.92	3.62	1.03	.09
" " wet	75.01	....	.89	.31	.05
Rye bran	12.50	4.60	2.32	2.28	1.40
" middlings	12.54	3.52	1.84	1.26	.81
Wheat bran	11.74	6.25	2.67	2.89	1.61
" middlings	9.18	2.30	2.63	.95	.63
Rice bran	10.20	12.94	.71	.29	.24
" polish	10.30	9.00	1.97	2.67	.71
Buckwheat middlings	14.70	1.40	1.38	.68	.34
Cotton-seed meal	7.81	6.95	6.79	2.88	.87
" hulls	10.17	2.40	.69	.25	1.02
Linseed meal (old process)	8.88	6.08	5.43	1.66	1.37
" " (new process)	7.77	5.37	5.78	1.83	1.39
Apples, fruit	85.30	.39	.13	.01	.19
Apple pomace	80.50	.27	.23	.02	.13
Dairy Products, etc.					
Whole milk	87.00	.75	.53	19	.18
Skim-milk	90.25	.80	.56	.20	.19
Cream	74.05	.50	.40	.15	.13
Buttermilk	90.50	.70	.48	.17	.16
Whey	92.97	.60	.15	.14	.18
Butter	79.10	.15	.12	.04	.04
Cheese	33.25	2.10	3.93	.60	.12
Live cattle	50 2	4.40	2.48	1.76	.16
Sheep	44.8	2.90	1.95	1.13	.14
Swine	42 0	1.80	1.76	.73	.10

AMOUNT OF SOIL INGREDIENTS WITHDRAWN BY VARIOUS CROPS, IN LBS. PER ACRE.

(HILGARD.)

Crops.	Total Ash.	Potash.	Lime.	Phosphoric Acid.	Chlorin.	Nitrogen.
Grapes, 1,000 lbs	....	5.00	1.00	1.52	.10	1.70
Crop of 10,000 lbs	....	50.00	10.00	15.20	1.00	17.00
Seeds, 646 lbs	....	1.48	.....	5.75	......	.....
Flesh, 9,154 lbs	....	47.44	......	8.93	......	......
Wood, 2,010 lbs	53.42	15.69	21.60	8.74	.61	......
Prunes, 1,000 lbs	3.03	2.66	.13	.53	.01	1.48
Crop of 30,000 lbs	120.90	79.70	3.92	15.95	.22	44.40
Pits, 1,635 lbs.	8.60	2.06	.52	2.80	.02	10.30
Flesh, 28,365 lbs	112.30	77.64	3.40	13.15	.20	34.10
Apricots, 1,000 lbs	5.16	2.83	.18	.71	.02	2.29
Crop of 30,000 lbs	154.80	84.98	5.45	21.38	.94	68.70
Pits, 1,740 lbs	12.25	1.36	.83	5.36	.19	15.00
Flesh, 28,260 lbs	142.55	83.62	4.65	16.02	.75	53.70
Oranges, 1,000 lbs	4.32	2.11	.99	.53	.04	1.83
Crop of 20,000 lbs	86.40	42.28	19.72	10.60	.80	36.60
Seeds, 240 lbs	6.90	2.74	1.32	1.61	.04	......
Flesh and rind, 19,760 lbs	79.50	39.54	18.40	8.99	.76	......
Roots, percentage	100.12	15.43	49.89	13.47	.72	.....
Stems, "	100.00	11.69	55.13	17.09	.15	......
Leaves "	99.91	16.51	56.38	3.27	4.03	......
Olives, 1,000 lbs	94.63	8.55	2.32	1.18	.23	5.85
Crop of 2,200 lbs	208.18	18.81	5.10	2.59	.50	12.86
Pits, 429 lbs	193.25	6.77	4.01	2.40	.48	9.67
Flesh, 1,771 lbs	14.56	12.04	1.09	.19	.02	3.19
Leaves, 4,400 lbs	190.16	58.05	88.53	20.08	.28	69.90
Wood, 11,000 lbs	123.18	24.46	66.63	14.87	......	117.67
Wheat, 1,000 lbs. (whole plant)	51.26	9.15	2.30	4.13	1.65	8.75
Crop of 4,800 lbs. (hay)	246.04	43.92	11.04	19.80	7.89	42.00
Grain, 20 bushels	24.00	7.85	.72	11.90	.02	24 00
Straw, 3,600 lbs	222.04	36.07	10.32	7.90	7.87	18.00
Alfalfa, 1,000 lbs	65.00	13.49	22.86	6.43	1.59	12.96
Crop of 12,000 lbs	780.00	161.88	274.32	77.16	19.08	155.52
Sugar beets (fresh), 1,000 lbs.	18.73	5.38	3.11	1.61	.86	2.38
Crop of 72,000 lbs	1349.72	387.44	224.08	116.16	61.68	173.40
Roots, 40,000 lbs	287.00	152.00	16.00	36.00	12.00	60.40
Tops, 32,000 lbs	1062.72	235.44	208.08	80.16	49.68	113.00
Ramie, 1,000 lbs	75.19	8.84	23.08	6.46	1.12	12.97
Crop of 14.25 tons	2143.57	251.98	657.82	155.70	51.85	369.70
Leaves, 4.25 tons	1641.35	68.13	566.91	77.13	41.56	206.10
Stalk (without bark), 7.25 tons.	410.48	155.99	71.77	67.71	2.50	105.85
Bark (cuticle and fibre), 2.75 tons	91.74	27.86	19.14	10.86	7.79	57.75
Cotton, 1,000 lbs	54.26	11.00	13.76	7.03	2.58	......
Crop of 3,200 lbs	173.60	35.26	44.04	22.54	8.27	.....
Leaves, 400 lbs	48.69	7.99	15.03	4.22	2.75	......
Stems, 1,200 lbs.	38.44	9.17	10.58	4.49	2.54	.....
Seeds, 800 lbs	29.37	8.99	3.07	9.74	.48	29.20
Burs, 400 lbs	52.01	7.42	14.16	3.57	2.14	......
Lint, 400 lbs	5.09	1.69	1.20	.52	.36	......

AMOUNT OF FERTILIZING MATERIALS CONTAINED IN DIFFERENT CROPS GROWN ON ONE ACRE. (VanSlyke.)

Kind of Crops.	Yield of Grain, Fruit, etc.	Yield of Straw, etc.	Pounds of Nitrogen.	Pounds of Phosphoric Acid.	Pounds of Potash.
Apples	10 to 20 tons.	....	26 to 52	2 to 4	40 to 80
Barley	20 to 40 bushels.	1,350 to 2,700 lbs.	37 to 74	11.5 to 23	34 to 68
Beans	20 to 40 bushels.	1,800 to 3,600 lbs.	50 to 100	20 to 40	35 to 70
Buckwheat	15 to 30 bushels.	1,200 to 2,400 lbs.	26.5 to 53	10.5 to 21	30 to 60
Cabbage	15 to 30 tons.	....	100 to 200	35 to 70	135 to 270
Clover, crimson (green)	....	7½ to 15 tons.	65 to 130	20 to 40	70 to 140
Clover, red, hay	....	1 to 2 tons.	41 to 82	9 to 18	44 to 88
Corn (grain alone)	30 to 60 bushels.	2,500 to 5,000 lbs.	42 to 84	16 to 32	17 to 34
Grapes	1 to 2 tons.	3,000 to 6,000 lbs.	7 to 14	18 to 36	26 to 52
Hops (whole crop)	1,600 to 3,200 lbs.	....	40 to 80	28 to 56	32 to 64
Mixed hay	....	1 to 2½ tons.	28 to 70	7 to 17.5	31 to 77
Oats	30 to 60 bushels.	1,600 to 3,200 lbs.	30 to 60	11 to 22	25 to 50
Onions	350 to 700 bushels.	....	28 to 56	10 to 20	20 to 40
Pears	8 to 16 tons.	....	16 to 32	5 to 10	13 to 26
Peas	15 to 30 bushels.	1,500 to 3,000 lbs.	54 to 108	16.5 to 33	26 to 52
Plums	4 to 8 tons.	....	15 to 30	2 to 4	20 to 40
Potatoes	100 to 200 bushels.	750 to 1,500 lbs.	16.5 to 33	10 to 20	31 to 62
Rye	15 to 30 bushels.	2,100 to 4,200 lbs.	24.5 to 49	13 to 26	21 to 42
Sugar beets	300 to 600 bushels.	3,000 to 6,000 lbs.	55 to 110	20 to 40	95 to 190
Timothy hay	....	1 to 2 tons.	25 to 50	10 to 20	30 to 60
Tobacco	800 to 1,600 lbs. leaves.	700 to 1,400 lbs. stems.	38 to 76	8 to 16	100 to 200
Tomatoes	5 to 10 tons.	....	16 to 32	10 to 20	27 to 54
Turnips	350 to 700 bushels.	2¼ to 5 tons.	40 to 80	26 to 52	90 to 180
Wheat	15 to 30 bushels.	1,600 to 3,200 lbs.	31 to 62	10 to 20	13 to 26

MINIMUM AMOUNT OF FARMYARD MANURE required to replace the Ingredients abstracted from the Soil by an Acre of Different Crops. (McConnell.)

Wheat	5 tons.	Turnips	15 tons.
Barley	5	Swedes	10
Oats	5	Mangolds	20
Meadow hay	8	Potatoes	10
Red clover	12	Cabbage	25
Beans	10	Carrots	10

AMOUNT AND QUALITY OF MANURE PRODUCED BY STOCK.

The various classes of farm animals will produce about the following quantities of solid and liquid manure during a year, viz.:

	Solid Manure.	Liquid Manure.
Horse	12,000 lbs.	3,000 lbs.
Cow	20,000 "	8,000 "
Sheep	760 "	380 "
Pig	1,800 "	1,200 "

Since a considerable portion of the manure is lost while the animal is working or is out-doors, the quantities secured in the manure-pile will not come up to these figures.

The quantities of urine voided by farm animals during twenty-four hours are on the average as follows, according to Wilckens: cows, 15–20 lbs.; horses, 20–27 lbs.; sheep, 2 lbs.; swine, 7–9 lbs. The capacity for liquid manure-tanks or cisterns intended to hold the fluid excrements of a herd of a certain size may readily be calculated on a basis of these figures (see tables on p. 137). 6000 lbs. (about 720 gallons) of urine per 1000 lbs. live weight of cattle, is a liberal estimate.

The quality of the manure produced will depend on the character of the feeding and the kind of stock kept. Rich feeding produces a rich manure, since, as shown in the table given below, only a relatively small portion of the valuable fertilizing ingredients of the food is retained in

the bodies of the animals, or is taken away in the products sold. Rich feeding, therefore, has a beneficial influence in two directions, larger yields of products being obtained, and a better quality of manure being produced.

COMPOSITION, AMOUNT, AND VALUE OF MANURE Produced by Different Kinds of Farm Animals.

(Results of experiments conducted at Cornell University Experiment Station.)

	Analysis and Value per Ton of Manure.					Amount and Value per 1000 lbs. Live Weight per Day.		
	Water.	Nitrogen.	Phosphoric Acid.	Potash.	Value per Ton.*	Pounds per Day.	Value per Day.*	Value per Year.*
	Per ct.	Per ct.	Per ct.	Per ct.			Cents.	
Sheep...	59.52	.77	9.39	.59	$3.30	34.1	7.2	$26 09
Calves..	77.73	.50	.17	.53	2.18	67.8	6.7	24.45
Pigs	74.13	.84	.39	.32	3.29	83 6	16.7	60.88
Cows ...	75.25	.43	.29	.44	2.02	74.1	8.0	29.27
Horses .	48.69	.49	.26	.48	2.21	48.8	7.6	27.74

QUANTITIES OF NITROGEN AND ASH CONSTITUents Voided by Animals or Obtained in Animal Products. (LAWES and GILBERT.)

	Percentage of Nitrogen.				Percentage of Ash Constituents.	
	Obtained as Animal Product.	Voided as Solid Excrement.	Voided as Liquid Excrement.	In Total Excrement.	Obtained as Live Weight or Milk.	Voided as Excrement or Perspiration.
Horse at rest ...	None.	43.0	57.0	100.0	None.	100.0
Horse at work...	None.	29.4	70.6	100.0	None.	100.9
Fattening oxen .	3.9	22.6	73.5	96.1	2.3	97.7
Fattening sheep.	4.3	16.7	79.0	95.7	3.8	96.2
Fattening pigs.	14.7	22.0	63.3	85.3	4.0	96.0
Milking cows....	24.5	18.1	57.4	75.5	10.3	89.7

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

PERCENTAGE COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS. (Beal.)

Name.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Lime.
				Soluble.	Reversed.	Total.	
Algæ (*Lyngbia majuscula*).	16.26	4.25	.79	.....	.....	.19	2.06
Ammonite	5.88	11.33	.....	.....	.....	3.43	.....
Apatite.	.....	.....	.....	.....	.....	36.08	.....
Ashes, anthracite coal	.....	.....	.10	.....	.....	.10	.....
" bituminous "	.....	.....	.40	.....	.....	.40	.....
" lime-kiln.	15.45	.....	1.20	.....	.....	1.14	48.50
" wood, leached.	30.22	.....	1.27	.....	.....	1.51	28.08
" " unleached	12.50	.....	5.25	.....	.....	1.70	34.00
Bat guano	40.09	8.20	1.31	2.37	1.24	3.80	.....
Bone-ash.	7.00	.....	.....	.....	.....	35.89	44.89
Bone-black.	4.60	.....	.....	.....	.....	28.28	.....
" " dissolved.	.....	.....	.....	15.40	1.30	17.00	.....
Bone meal	7.50	4.05	.....	.40	7.60	23.25	.....
" " dissolved.	.....	2.60	.....	13.53		17.60	.....
" " free from fat	.....	6.20	.....	.....	.....	20.10	.....
" " from glue factory	.....	1.70	.....	.....	.....	29.90	.....
Carnallite.	.....	.....	13.60	.....	.....	.....	.....
Caribbean guano	7.31	.....	.....	.....	.....	26.77	39.95
Castor pomace	9.50	5.50	1.10	.....	.....	1.75	.....
Cotton-hull ashes	7.80	.....	22.75	1.25	6.50	8.85	9.60
Cotton-seed meal, decort	7.75	6.79	1.77	.....	.....	2.88	.....
" " " undecort.	.....	4.30	1.50	.....	.....	3.10	.....
Cuba guano	24.27	1.67	.....	.....	.....	13.35	.....
Dried blood.	12.50	10.52	.....	.....	.....	1.91	.
Dried fish.	12.75	7.25	.....	.55	2.60	8.25	.....
Eel-grass (*zostera marina*).	81.19	.35	.32	.....	.....	.07	.51
Gas lime	22.28	.....	.....	.....	.....	.....	43.66
Horn and hoof waste	10.17	13.25	.....	.....	.....	1.83	.....
Kainit	3.20	.....	13.54	.....	.....	.....	1.15
Kelp (*laminaria*)	87.75	.20	.24	.....	.....	.06	.40
Kieserite.	22.70	.....	.....	.....	.....	.....	2.82
Krugite	4.82	.....	8.42	.....	.....	.....	12.45
Lobster shells	7.27	4.50	.....	.....	.....	3.52	22.24
Marls, Kentucky.	1.50	.....	.1–3	.....	.....	.2	3–34
" Maryland and Virginia	1.50	.....	.2–5	.....	.....	.0–2	0–40
" New Jersey green sand	1.50	.....	3.5–7	.....	.....	.1–4	1–9
" North Carolina.	1.50	.....	.2–1.5	.....	.....	0–.4	5–45
Meat scrap	12.09	10.44	.....	.....	.....	2.07	.....
Mona Island guano	13.32	.76	.....	.....	7.55	21.88	37.49
Muck.	50.00	1.10	.15	.....	.....	.10	.....
Mud, salt.	60.00	.40	.35	.....	.....	.10	.90
Muriate of potash.	2.00	.....	51.48	.....	.....	.....	.....
Navassa phosphate	7.60	.....	.....	.....	.....	34.27	37.45
Nitrate of soda	1.40	15.70	.....	.....	.....	.....	.....
Oleomargarine refuse.	8.54	12.12	.....	.....	.....	.88	.....

PERCENTAGE COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS.—*Continued.*

Name.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Lime.
				Soluble.	Reversed.	Total.	
Oyster-shell lime*	15.00	.....	.05	.....	.....	.18	55.00
Peat	61.50	.85	.18	.....	.....	.08	.....
Peruvian guano	14.81	7.35	2.65	3.20	4.10	15.30	.....
Phosphates, Florida	2.25	.....	.....	.....	.....	24.50	28.50
Plaster, pure†	.....	.....	.....	.....	.....	.....	20.93
Seaweed	81.90	.29	.40	.....	.....	.08	.....
" ashes	1.47	.....	.92	.....	.....	.30	6.06
" mixed	81.50	.73	1.50	.....	.....	.18	.23
Sewage sludge, precipitated	88.49	.05	.05	.....	.....	.10	1.58
Soot	5.54	.....	1.83	.....	.....	.....	.....
S. Carolina rock, dissolved	.....	.....	.....	11.60		15.20	.....
" " " ground	1.50	.....	.....	.27	.07	28.03	41.87
Spent tan-bark ashes	3.61	.....	2.04	.....	.....	1.61	33.46
Sumac waste	63.06	1.19	3.25	.....	.....	.....	1.14
Sulfate of ammonia	1.00	20.50	.....	.....	.....	.....	.....
Sulfate of potash and magnesia	4.75	.....	25.50	.....	.....	.....	2.57
Sulfate of potash, high grade	2.54	.....	33.40	.....	.....	.....	.....
Sylvanite	7.25	.....	16.65	.....	.....	.....	.....
Tankage	10.00	6.70	.....	.30	5.10	11.80	.....
Thomas slag	1.45	.....	.....	.00	3.06	23.49	48.66
Tobacco stalks	6.18	3.71	5.02	.....	.....	.65	2.22
" stems	10.00	2.35	8.20	.....	.....	.70	4.20
Wool washings	.....	.....	3.92	.....	.....	.....	.....
Wool waste	15.80	6.50	‡1.20	.....	.....	.35	.11
Composition of Farm Manures.							
Barnyard manure, average	68.87	.49	.43	.....	.....	.32	.....
Cattle excrement, solid, fresh	.....	.29	.10	.....	.....	.17	.....
Cattle urine, fresh	.....	.58	.49	.....	.....	.....	.....
Hen manure, fresh	60.00	1.10	.56	.....	.....	.85	.....
Horse excrement, solid	.....	.44	.35	.....	.....	.17	.....
Horse urine, fresh	.....	1.55	1.50	.....	.....	.....	.....
Human excrement, solid	77.20	1.00	.25	.....	.....	1.09	.....
Human urine	95.90	.60	.20	.....	.....	.17	.....
Pigeon manure, dry	10.00	3.20	1.00	.....	.....	1.90	2.10
Poudrette, night soil	50.00	.80	.30	.....	.....	1.40	.80
Sheep excrement, solid, fresh	.....	.55	.15	.....	.....	.31	.....
Sheep urine, fresh	.....	1.95	2.26	.....	.....	.01	.....
Stable manure, mixed	73.27	.50	.60	.....	.....	.30	.....
Swine excrement, solid, fresh	.....	.60	.13	.....	.....	.41	.....
Swine urine, fresh	.....	.43	.83	.....	.....	.07	.....

* 18.5 per cent carbonate.

† Nova Scotia plaster contains 94 per cent pure gypsum and 4 per cent carbonate of lime; Onondaga and Cayuga, 65–75 per cent gypsum and 18–28 per cent carbonate of lime.

‡ Sometimes as high as 5 per cent.

EXHAUSTION OF FERTILIZERS. (Scotch Authority.)

ON CULTIVATED CLAY LOAM.

Kind of Fertilizer.	Exhausted [in Years].	Per Cent remaining in the Soil Unexhausted at End of Each of First Six Years.					
		1	2	3	4	5	6
Lime	12	80	65	55	45	35	25
Bone meal	5	60	30	20	10	..	..
Phosphatic guanos	5	50	30	20	10	..	..
Dissolved bones and plain superphosphates	4	20	10	5	..	..	..
High-grade ammoniated fertilizers, guano, etc.	3	30	20	..	..	..	..
Cotton-seed meal	5	40	30	20	10	..	..
Stable manure	5	60	30	20	10	..	..

ON CULTIVATED LIGHT OR MEDIUM SOILS.

Lime	10	75	60	40	30	20	15
Bone meal	4	60	30	10	..	..	..
Phosphatic guanos	4	50	20	10	..	..	..
Dissolved bones and plain superphosphate	3	20	10	5	..	..	..
High-grade ammoniates, guanos	3	30	20	..	..	..	..
Cotton-seed meal	4	40	30	20	10	..	..
Stable manure	4	60	30	10	..	..	..

ON CULTIVATED PASTURE LAND.

Lime	15	80	70	60	50	45	40
Bone meal	7	60	50	40	30	20	10
Phosphatic guanos	6	50	40	30	20	10	..
Dissolved bone, etc	4	30	20	10	..	..	..
High-grade ammoniated guanos	4	30	20	10	..	..	..
Cotton-seed meal	5	40	30	20	10	..	..
Stable manure	7	60	50	40	30	20	10

Sulfate of ammonia, nitrate of soda, sulfate, nitrate, and muriate of potash are generally held to be entirely exhausted by the crops grown the season of their application.

EQUIVALENT QUANTITIES OF FERTILIZING MATERIALS. (Wheeler and Hartwell.)

For	May be Substituted any One of these Materials.		
100 lbs. nitrate of soda	76 lbs. sulfate of ammonia	141 lbs. dried blood	235 lbs. cotton-seed meal.
100 lbs. sulfate of ammonia	132 lbs. nitrate of soda	186 lbs. dried blood	311 lbs. cotton-seed meal
100 lbs. dried blood	71 lbs. nitrate of soda	54 lbs. sulfate of ammonia	167 lbs. cotton-seed meal
100 lbs. cotton-seed meal	43 lbs. nitrate of soda	32 lbs. sulfate of ammonia	60 lbs. dried blood
100 lbs. diss. phosphate rock	76 lbs. diss. bone black	33 lbs. double superphosphate	
100 lbs. diss. bone black	131 lbs. diss. phosphate rock	43 lbs. double superphosphate	
100 lbs. double superphosphate	308 lbs diss. phosphate rock	235 lbs. double superphosphate	
100 lbs. tankage	39 lbs. nitrate of soda and 38 lbs. phosphate rock.		
	29 lbs. sulfate of ammonia and 38 lbs. phosphate rock.		
	55 lbs. dried blood and 38 lbs. phosphate rock.		
	91 lbs. cotton-seed meal and 38 lbs. phosphate rock.		
	80 lbs. dry ground fish and 14 lbs. phosphate rock.		
	33 lbs. nitrate of soda and 4.5 lbs. fine-ground bone.		
100 lbs. dry ground fish	48 lbs. nitrate of soda and 31 lbs. diss. phosphate rock.		
	37 lbs. sulfate of ammonia and 31 lbs. diss. phosphate rock.		
	68 lbs. dried blood and 31 lbs. diss. phosphate rock.		
	113 lbs. cotton-seed meal and 31 lbs. diss. phosphate rock.		
	80 lbs. tankage and 17 lbs. nitrate of soda.		
	36 lbs. fine ground bone and 44 lbs. nitrate of soda.		
100 lbs. fine-ground bone	13 lbs. nitrate of soda and 85 lbs. diss. phosphate rock.		
	10 lbs. sulfate of ammonia and 85 lbs. diss. phosphate rock.		
	18 lbs. dried blood and 85 lbs. diss. phosphate rock.		
	30 lbs. cotton-seed meal and 85 lbs. diss. phosphate rock.		
	33 lbs. tankage and 72 lbs. diss. phosphate rock.		
	27 lbs. dry ground fish and 76 lbs. diss. phosphate rock		

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, 1896.

	Cents per lb.
Nitrogen—	
in ammonia salts	15
in nitrates	13½
Organic nitrogen—	
in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers	14
in cotton-seed meal, linseed meal, and castor pomace	12
in fine-ground bone and tankage	13½
in fine-ground medium bone and tankage	12
in medium bone and tankage	9
in coarse bone and tankage	3
in hair, horn-shavings, and coarse fish scraps	3
Phosphoric acid—	
soluble in water	5½
soluble in ammonium citrate	5
in dry fine-ground fish and in fine bone and tankage	5
in fine medium bone and tankage	4
in medium bone and tankage	2½
in coarse bone and tankage	2
in fine-ground fish, cotton-seed meal, linseed meal, castor pomace, and wood ashes	4½
insoluble (in ammonium citrate solution), in mixed fertilizers	2
Potash as high-grade sulfate, and in mixtures free from muriate	5
as muriate	4½

The manurial constituents contained in feeding stuffs are valued as follows :

Organic nitrogen	12
Phosphoric acid	4½
Potash	4½

CONVERSION TABLE FOR CALCULATING FERTILIZING INGREDIENTS.

Amount of	Multiplied by	Gives Corresponding Amount of
Nitrogen	1.214	Ammonia.
"	6.07	Nitrate of soda.
Ammonia..................	.824	Nitrogen.
"	3.882	Sulfate of ammonia.
"	3.147	Chlorid of ammonia.
"	3.706	Nitric acid.
"	5.0	Nitrate of soda.
Nitrate of soda...............	.165	Nitrogen.
" " "	.2	Ammonia.
Sulfate of ammonia	.212	Nitrogen.
" " "	.258	Ammonia.
Potash (anhydrous)...	1.85	Sulfate of potash.
"	1.585	Muriate of potash.
Sulfate of potash....	.54	Potash.
Muriate of potash............	.632	"
Phosphoric acid (anhydrous).	2.183	Tri-calcium phosphate.
" "	1.915	Di-calcium phosphate.
" "	1.648	Mono-calcium phosphate.
Mono-calcium phosphate ...	1.325	Tri-calcium phosphate.
Di-calcium phosphate........	1.565	" " "
Tri-calcium phosphate......	.459	Phosphoric acid.
Lime (calcium oxid).........	1.845	Tri-calcium phosphate.
"	1.786	Carbonate of lime.
Chlorin.................. ...	1.648	Sodium chlorid.

XI. AGRICULTURAL ENGINEERING.

REASONS FOR TILE-DRAINING LAND.

(CHAMBERLAIN.*)

Land should be drained, because:

1. Tile drainage makes all tillage and harvesting operations easier and more rapid, physically and mechanically.

2. Drainage removes both the excess surface-water, and the surplus water in the soil and the subsoil.

3. Drainage prevents loss of fertility by surface wash.

4. Drainage will add fertility to the soil with each rainfall.

5. Drainage helps to warm the soil as well as to dry it, giving best conditions for plant growth.

6. Drainage lengthens the season of tillage, crop, growth, and harvest.

7. Drainage increases the extent of root pasturage.

8. Drainage helps to disintegrate the soil and make pulverization possible.

9. Drainage greatly diminishes the effect of frost in heaving out wheat, clover, etc., in winter and spring.

10. Drainage on clayey soils helps the crops to resist drought better.

11. Drainage often, though not always, diminishes the suddenness and violence of floods.

12. Drainage, both open and with tiles, improves the health of a region.

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* Tile Drainage, by W. I. Chamberlain, Medina, Ohio, 1891, 35 cents.

NUMBER OF RODS AND OF TILES PER ACRE, WITH DRAINS AT VARIOUS DISTANCES APART. (SCOTT.)

Distance between the Drains.	Rods (5½ Yards) per Acre.	12-inch Tile.	13-inch Tile.	14-inch Tile.	15-inch Tile.
Feet.					
15	176	2904	2680	2489	2323
18	146	2420	2234	2074	1936
21	125	2074	1915	1778	1659
24	110	1815	1676	1555	1452
27	97	1613	1489	1383	1290
30	88	1452	1340	1244	1161
33	80	1320	1219	1131	1056
36	72	1210	1117	1037	968
39	67	1117	1031	957	893
42	62	1037	958	888	829

SIZE OF TILE PIPES

Required for Draining under Average Conditions.

(WARING.)

The drains being laid four feet, or more, deep, and laid on a well-regulated fall of three inches in a hundred feet:

For	2 acres	....	1½-inch pipes		
"	8	"	....	2¼ "	"
"	20	"	....	3½ "	"
"	40	"	.... two	3½ "	"
"	50	"	....	6 "	"
"	100	"	....	8 "	"

These drains will remove the water fast enough for all practical purposes, even after heavy storms; if the pipes are securely laid, the drains will only be benefited by the occasional cleaning they will receive when running "more than full."

Table of Size of Tile Pipe of Main Drain.

(McConnell.)

Fall.	Acres Drained.					
	3-inch Tile.	4-inch Tile.	6-inch Tile.	8-inch Tile.	10-inch Tile.	12-inch Tile.
1 foot in 20	18.6	26.8	74.4	150.0	270.0	426.0
1 " " 30	15.1	21.8	60.4	128.0	220.8	346.0
1 " " 40	12.9	18.6	51.6	108.8	189.6	298.4
1 " " 50	11.9	17.0	47.7	98.0	170.4	269.0
1 " " 60	10.9	15.6	43.4	90.0	156.0	246.0
1 " " 70	10.0	14.5	39.9	83.0	144.4	228.1
1 " " 80	9.3	13.4	37.2	77.0	135.0	213.0
1 " " 90	8.1	12.6	35.0	72.5	127.0	200.5
1 " " 100	7.3	11.9	33.1	69.2	120.6	190.5
1 " " 150	6.7	9.5	26.6	56.0	97.3	154.4
1 " " 200	5.7	8.2	22.8	48.0	83.9	132.5
1 " " 250	5.1	7.5	20.4	42.4	74.4	117.0
1 " " 300	4.6	6.9	18.4	38.2	65.5	107.0
1 " " 400	4.1	5.9	16.5	32.6	60.3	90.7
1 " " 500	3.7	5.2	14.8	30.1	54.0	81.6
1 " " 600	3.3	4.7	13.3	28.0	48.6	74.0
1 " " 800	2.9	4.1	11.4	24.0	41.9	65.0
1 " " 1000	2.6	3.7	10.2	21.2	37.2	56.0
1 " " 1500	2.1	3.0	8.5	16.8	30.8	47.0
1 " " 2000	1.9	2.8	7.4	15.0	25.0	40.8

Rule for Obtaining Size of Main Pipes.—Multiply the square root of the number of small drains (of fair average length) by the diameter of small pipes; the quotient gives the diameter of main.

If the distance apart of drains in feet be denoted by F, that in links by L, and the length of drains in chains per acre by C, then

$$C = \frac{660}{F} = \frac{1000}{L}.$$

Number of 12-inch Pipes Required per Acre at Different Distances between the Drains:

Distance. Feet.	Number.	Distance. Feet.	Number.
12	3630	33	1320
15	2904	40	1089
18	2420	50	871
21	2073	60	726
27	1613		

RISE OF THE SLOPE FOR 100 FEET. (Waring.)

Table I. gives the rise of the slope for 100 feet of the horizontal measurement.

Table II., the rise of the slope for 100 feet of its own length.

Table No. I.				Table No. II.			
Deg.	Feet.	Deg.	Feet.	Deg.	Feet.	Deg	Feet.
5	8.749	50	119.175	5	8.716	50	76.604
10	17.633	55	142.815	10	17.365	55	81.915
15	26.795	60	173.205	15	25.882	60	86.602
20	36.397	65	214.451	20	34.202	65	90.631
25	46.631	70	274.748	25	42.262	70	93.969
30	57.735	75	373.205	30	50	75	96.593
35	70.021	80	567.128	35	57.358	80	98.481
40	83.910	85	1143.010	40	64.279	85	99.619
45	100			45	70.711		

Example.—If the horizontal measurement is 100 feet, and the slope is at an angle of 10°, the rise will be 17.633 feet.

If the sloping line (at an angle of 15°) is 100 feet, it rises 25.882 feet.

QUANTITY OF EARTH REMOVED PER ROD OF DRAINS OF VARIOUS DIMENSIONS. (Scott.)

Depth of Drain, Feet.	Mean Width of Drains.											
	In. 7	In. 8	In. 9	In. 10	In. 11	In. 12	In. 13	In. 14	In. 15	In. 16	In. 17	In. 18
	Cubic Yards.											
2½	0.89	1.02	1.14	1.27	1.40	1.53	1.65	1.78	1.91	2.04	2.16	2.29
3	1.07	1.22	1.37	1.53	1.68	1.83	1.98	2.14	2.29	2.24	2.60	2.75
3½	1.25	1.42	1.60	1.78	1.96	2.14	2.32	2.49	2.67	2.85	3.03	3.21
4	1.42	1.63	1.83	2.04	2.24	2.44	2.65	2.85	3.05	3.26	3.46	3.66
5	1.78	2.03	2.29	2.54	2.80	3.05	3.31	3.56	3.82	4.07	4.33	4.58

"If a 4-ft. drain be cut 14 in. wide at top and 4 in. at bottom, the mean width will be 9 in., and the quantity of earth excavated in cutting each rod will be 1.83 cubic yards ; if

the same drain be cut 18 in. at top and 8 in. at bottom, the mean width will be 13 in., and 2.65 cubic yards of earth will have to be removed in cutting each rod: so that if the digging of the drain costs 6 cents per cubic yard of earth moved the narrow drain will cost 11 cents per rod, and the other nearly 16 cents per rod, showing the cost to be one half larger, quite unnecessarily.

"The same table will be found useful in helping to fix the relative prices of deep and shallow drains; but it must be recollected that the deeper drains will be increased in cost not only by reason of the greater quantity of earth which has to be moved, but also because of the increased labor of lifting the earth to the surface from a greater depth."

RAINFALL. (McConnell.)

Inches of Depth.	Cubic Feet per Acre.	Gallons per Acre.	Tons per Acre.
1	3,630	22,635	101.1
2	7,260	45,270	202.2
3	10,890	67,905	303.3
4	14,520	90,539	404.4
5	18,150	113,174	505.5
6	21,780	135,809	606.6
7	25,410	158,444	707.7
8	29,040	181,072	808.8
9	32,670	203,714	909.9
10	36,300	226,349	1011.0
11	39,930	248,984	1112.1
12	43,560	271,619	1213.2

TABLE SHOWING THE FORCE AND VELOCITY OF WIND. (Waring.)

Miles per Hour.	Feet per Minute.	Lbs. Pressure on 1 sq. ft.	Description.
1	88	.005	Barely observable.
2	176	.020	Just perceptible.
3	264	.045	
4	352	.080	Light breeze.
5	440	.125	Gentle, pleasant wind
6	528	.180	
8	704	.320	
10	880	.500	Brisk blow.
15	1320	1.125	
20	1760	2.000	Very brisk.
25	2200	3.125	
30	2640	4.500	High wind.
35	3080	6.125	
40	3520	8.000	Very high.
45	3960	10.125	
50	4400	12.500	Storm.
60	5280	18.000	Great storm.
80	7040	32.000	Hurricane.
100	8800	50.000	Tornado, uprooting trees, sweeping off buildings, etc.

NUMBER OF SQUARE FEET AND ACRES THAT A First-class Windmill can Irrigate One Inch in 8 Hours, Raising the Water 10, 15 or 25 Feet.

(A. R. Wolff.)

Size of Windmill.	10 Feet.		15 Feet.		25 Feet.	
	Sq. Ft.	Acres	Sq. Ft.	Acres	Sq. Ft.	Acres
8½ ft. diam. of wheel..	11,736.34	.269	7,824.74	.180	4,744.74	.109
10 " " " " ..	37,161.74	.853	24,774.75	.569	14,767.83	.339
12 " " " " ..	66,765.16	1.533	44,509.85	1.022	26,134.57	.600
14 " " " " ..	85,982.05	1.974	57,321.11	1.316	34,757.03	.798
16 " " " " ..	120,106.14	2.757	80,070.76	1.838	49,742.00	1.142
18 " " " " ..	192,446.10	4.418	123,164.58	2.827	75,215.14	1.727
20 " " " " ..	238,395.08	5.473	158,930.31	3.649	96,211.50	2.209
25 " " " " ..	410,038.09	9.413	273,359.24	6.275	163,533.37	3.75
30 " " " " ..	831,686.24	19.093	561,197.56	12.883	331,752.96	7.616

TABLE SHOWING CAPACITY OF WINDMILLS.

(A. R. Wolff.)

	Designation of Mill.	Velocity of Wind in Miles per hour.	Revolutions of Wheel.	Gallons of Water Raised per Minute to an Elevation of						Equivalent Actual Useful Horse-power Developed.	Average Number of Hours per Day During which this Result will be Obtained.
				25 ft.	50 ft.	75 ft.	100 ft.	150 ft.	200 ft.		
I	8½-ft. wheel	16	70 to 75	6.162	3.016	....	....	....	....	.04	8
II	10 " "	16	60 " 65	19.179	9.563	6.538	4.750	....	....	.12	8
III	12 " "	16	55 " 60	33.941	17.952	17.952	11.851	5.680	....	.21	8
IV	14 " "	16	50 " 55	45.139	22.569	15.304	11.246	7.807	4.998	.28	8
V	16 " "	16	45 " 50	64.600	31.654	19.542	16.150	9.771	8.075	.41	8
VI	18 " "	16	40 " 45	97.682	52.165	32.513	24.421	17.485	12.211	.61	8
VII	20 " "	16	35 " 40	124.950	63.750	40.800	31.248	19.284	15.938	.78	8
VIII	25 " "	16	30 " 35	212.381	106.964	71.604	49.725	27.349	26.741	1.34	8

TABLE SHOWING ECONOMY OF WINDMILLS.

(A. R. WOLFF.)

	Designation of Mill.	Gallons of Water Raised 25 Feet per Hour.	Equivalent Actual Useful Horse-power Developed.	Average Number of Hours per Day During which this Quantity will be Raised.	Expense of Actual Useful Power Developed, in cents per hour.					Expense per Horse-power, in cents per hour.
					For Interest on First Cost (first cost including cost of windmill, pump, and tower) at 5% per annum.	For Repairs and Depreciation (5% of first cost per annum).	For Attendance.	For Oil.	Total	
I	8½-ft. wheel	370	.04	8	.25	.25	.06	.04	.60	15.0
II	10 " "	1,151	.12	8	.30	.30	.06	.04	.70	5.8
III	12 " "	2,036	.21	8	.36	.36	.06	.04	.82	3.9
IV	14 " "	2,708	.28	8	.75	.75	.06	.07	1.63	5.8
V	16 " "	3,876	.41	8	1.15	1.15	.06	.07	2.43	5.9
VI	18 " "	5,861	.61	8	1.35	1.35	.06	.07	2.83	4.6
VII	20 " "	7,497	.79	8	1.70	1.70	.06	.10	3.56	4.5
VIII	25 " "	12,743	1.34	8	2.05	2.05	.06	.10	4.26	3.2

NOMINAL HORSE-POWER REQUIRED FOR THE DISCHARGE OF GIVEN QUANTITIES OF WATER WITH LIFTS OF 10 AND 20 FEET. (Scott.)

Diameter of Pipe, Inches.	Gallons Discharged per Minute.	Nominal H.P. required for a 10-foot Lift.	Nominal H.P. required for a 20-foot Lift.
3	100	1	2
4	200	1½	3
5	350	2	4
6	500	2½	5
7	759	3	6
8	1000	4	8
10	1500	6	10
12	2300	8	14
14	2800	10	16
15	3300	12	20
18	6000	20	35

IRRIGATION. (Yearbook U. S. Dept. of Agriculture.)

A *water right* is the right or privilege of using water for irrigating purposes, either in a definite quantity or upon a prescribed area of land, such right or privilege being customarily acquired either by priority of use or by purchase. In many parts of the arid region a water right is an exceedingly valuable property. The average value of the water rights of the entire arid region, as determined by the census of 1890, was $26 per acre, and there are fruit-growing districts in California where water rights have been sold at as high as $1500 per miner's inch, or from $100 to $500 per acre, according to the amount used on any given area of land.

The *duty of water* is the extent of the service it will perform when used for irrigating purposes, that is, the number of acres a given quantity of water will adequately irrigate under ordinary circumstances. This is usually from 100 to 200 acres for each second-foot. Where water is abundant the duty has been known to be as low as 50 acres, and where very scarce as high as 500 acres, to the second-foot.

A *miner's inch* is theoretically such a quantity of water as will flow through an aperture 1 inch square in a board 2 inches thick under a head of water of 6 inches in one second of time, and it is equal to 0.194 gallon, or 0.0259337 cubic foot, per second, or to 11.64 gal., or 1.556024 cubic ft., per minute. The amount of water flowing through a given aperture in a given time varies, however, with the head of water over the opening, and also with the form of the opening. In Colorado the miner's inch legalized by statute equals 11.7 gal. per min. The California miner's inch, however, equals only 9 gal. per min., 100 Colorado inches being, accordingly, equal to 130 California inches. One hundred Colorado inches will cover an acre to a depth of 5.2 ft. in 24 hours; 100 California inches will cover the same area only to a depth of 4 ft. in the same time. Fifty California inches are, therefore, approximately equal to 1 second-foot, and 50 Colorado inches equal to about three tenths more.

An *acre-foot of water* is the amount required to cover an acre of ground to a depth of 1 foot. This is 43,560 cubic feet, or 325,851.45 gal. Its weight is 1213 tons 2113 pounds, at 2240 pounds to the ton.

The amount of water required to cover an acre of ground to a depth of 1 inch is 3630 cubic feet, or 27,154.29 gal. Its weight is 101 tons $362\frac{3}{4}$ pounds, at 2240 pounds to the ton.

A *second-foot* is the most satisfactory because the most definite unit of measurement for flowing water. It is used by the U. S. Government in the gauging of rivers and streams, and is rapidly superseding the miner's inch in the measurement of water for irrigation. It is the quantity represented by a stream 1 foot wide and 1 foot deep flowing at the average rate of 1 foot per second. In other words, it is 1 cub. ft. per second, 60 cub. ft. per min., 3600 cub. ft. per hour, etc. A stream flowing continuously at the average rate of 1 second-foot would carry in one day of 24 hours 86,400 cub. ft., or 646,316.9 gal., sufficient to cover $1\frac{119}{121}$ acres to a depth of 1 ft. Flowing continuously for one year of 365 days, such a stream would carry 31,536,000 cub.

ft., or 235,905,678.7 gal., sufficient to cover $723\frac{117}{121}$ acres to a depth of 1 ft.

The *sub-humid region* is the strip of country running north and south between the arid region, where irrigation is absolutely necessary to the successful prosecution of agriculture, and those portions of the United States in which the rainfall is usually sufficient for agricultural purposes. It includes portions of North Dakota, South Dakota, Nebraska, Kansas, and Texas, and may be described as a region where irrigation is not always necessary, but where agricultural operations cannot, with any assurance of success, be undertaken without it.

The average *value of the irrigated land in farms* in the United States was ascertained by the census of 1890 to be $83.28 per acre, and that of the non-irrigated land in farms $20.95 per acre.

The average annual value of the agricultural products of the irrigated land was ascertained to be $14.89 per acre irrigated, and that of those of the non-irrigated land $6.80 for each acre improved.

The average first cost of the irrigated land, including purchase money, water rights, etc., was ascertained to have been $8.15 per acre, and the average annual cost of the water supply $1.07 per acre.

The total value of the irrigated farms of the United States, as reported by the farmers themselves, was, in round figures, $296,850,000, an increase of $219,360,000, or 283 per cent, upon their cost, including land, water right, fences, and preparation for cultivation.

The total value of the productive irrigating systems was found to be $94,412,000, an increase of $64,801,000, or 219 per cent, upon their cost.

CARRYING CAPACITY OF PIPES, GALLONS PER MINUTE. (WILCOX.)

Size of Pipe.	1-inch Fall per 100 ft.	2-inch Fall per 100 ft.	3-inch Fall per 100 ft.	6-inch Fall per 100 ft.	9-inch Fall per 100 ft.	1-foot Fall per 100 ft.	2-foot Fall per 100 ft.	3-foot Fall per 100 ft.
3 inch.	13	19	23	32	40	46	64	79
4 "	27	38	47	66	81	93	131	163
6 "	75	105	129	183	224	258	364	450
8 "	153	216	265	375	460	527	750	923
9 "	205	290	355	503	617	712	1,006	1,240
10 "	267	378	463	655	803	926	1,310	1,613
12 "	422	596	730	1,033	1,273	1,468	2,076	2,554
15 "	740	1,021	1,282	1,818	2,224	2,464	3,617	4,467
18 "	1,168	1,651	2,022	2,860	3,508	4,045	5,704	7,047
24 "	2,396	3,387	4,155	5,874	7,202	8,303	11,744	14,466
30 "	4,187	5,920	7,252	10,557	12,580	14,504	20,516	25,277

FLOW OF WATER THROUGH STRAIGHT PIPES

(COLLET.)

Flowing Full, in Gallons per Minute.

Diam. in Inches.	Head of Water Divided by Length of Pipe.								
	$\frac{1}{100}$	$\frac{1}{50}$	$\frac{1}{25}$	$\frac{1}{10}$	$\frac{2}{10}$	$\frac{3}{10}$	$\frac{5}{10}$	$\frac{8}{10}$	$\frac{1}{1}$
$\frac{1}{16}$	......	......	.....	.024	.036	.046	.06	.077	.086
$\frac{1}{8}$	......	.....	...	.056	.075	.089	.124	.158	.18
$\frac{3}{16}$	......	..	......	.14	.21	.26	.34	.44	.50
$\frac{1}{4}$	.....	...	......	.31	.44	.52	.72	.92	1.04
$\frac{3}{8}$	.22	.33	.5	.83	1.2	1.5	2.0	2.6	2.9
$\frac{1}{2}$	.46	.70	1.0	1.8	2.5	3.1	4.1	5.3	6.0
$\frac{3}{4}$	1.33	1.98	2.9	4.9	7.1	8.9	11.7	15	16.9
1	2.79	4.15	6.1	10	14.8	18.4	24	31	35
$1\frac{1}{4}$	4.96	7.36	10.8	18	26	32	42	54	61
$1\frac{1}{2}$	7.93	11.75	17.2	28	41	51	67	86	97
$1\frac{3}{4}$	11.7	17.4	25.5	42	61	76	100	128	144
2	16.6	24	36	59	86	106	140	179	202
$2\frac{1}{2}$	29	43	63	104	151	188	246	315	354
3	46	69	101	166	240	298	390	500	562
4	98	144	210	344	498	617	808	1033	1162
5	173	254	370	606	876	1085	1419	1815	2040
6	227	404	589	959	1389	1720	2248	2876	3230

If the diameter be doubled, nearly 5.8 times the quantity can be passed

POWER REQUIRED TO RAISE WATER FROM DEEP WELLS BY PUMPING. (Appleby.)

Gallons of water raised per hour	200	350	500	650	800	1000
Height of lift for one man, in feet	90	51	36	28	22	18
" " " " " donkey, in feet	180	102	72	56	45	36
" " " " " horse, "	630	357	252	196	154	126
" " " " " H.P. steam, in feet	990	561	396	308	242	198

APPROXIMATE COST OF DIFFERENT KINDS OF PIPE USED FOR IRRIGATION. (Wilcox.)

Diameter in Inches.	Sheet Iron or Steel Pipe, No. 16 B.W.G.	Sheet Iron or Steel Pipe, No. 14 B.W.G.	Sheet Iron or Steel Pipe, No. 12 B.W.G.	Cast-iron Pipe, Class B, or Medium.	Vitrified Clay Pipe.	Wooden Pipe.	Cement Pipe.
6	$0.32	$0.41	$0.52	$0.72½	$0.16½	......	$0.12
8	.42	.51	.62	1.04½	.22	......	.20
10	.53	.60	.85	1.42	.33	......	.26
12	.63	.68	.98	1.84	.41½	......	.32
14	.69	.75	1.17	2.30	.55	$0.74	.38
16	.82	.93	1.25	2.83	.68¾	.94	.45
18	.91	1.00	1.43	3.37	.82¼	1.08	.53
20	1.00	1.14	1.63	3.97	.96½	1.22	.60
22	1.05	1.30	1.85	4.62	1.21	1.32	.68
24	....	1.46	2.00	5.33	1.37½	1.40	.80

AVERAGE COST PER MILE OF CONSTRUCTING IRRIGATING CANALS AND DITCHES.

(Eleventh U. S. Census.)

States and Territories.	Under 5 Feet in Width.	5 to 10 Feet in Width.	10 Feet and Over in Width.
General average	$481	$1,628	$5,603
Arizona	$471	$1,674	$5,274
California	885	5,957	15,511
Colorado	380	1,131	5,258
Idaho	205	810	1,320
Montana	325	800	2,300
Nevada	200	1,150	......
New Mexico	310	581	6,666
Oregon	260	1,060	1,300
Utah	493	1,025	3,072
Washington	285	1,236	2,571
Wyoming	......	837	3,884
Sub-humid region	303	447	1,884

THE CALIFORNIA WEIR TABLE. (Wilcox.)

Depth.	Miner's Inches.	Depth.	Miner's Inches.	Depth.	Miner's Inches.	Depth.	Miner's Inches.
⅛	.01	3⅞	2.56	7⅝	7.04	12¾	15.27
¼	.04	4	2.69	7¾	7.22	13	15.72
⅜	.07	4⅛	2.81	7⅞	7.40	13¼	16.18
½	.12	4¼	2.93	8	7.58	13½	16.64
⅝	.17	4⅜	3.07	8⅛	7.76	13¾	17.10
¾	.22	4½	3.19	8¼	7.93	14	17.57
⅞	.27	4⅝	3.33	8⅜	8.12	14¼	18.04
1	.33	4¾	3.47	8½	8.30	14½	18.52
1⅛	.39	4⅞	3.61	8⅝	8.48	14¾	19.00
1¼	.46	5	3.75	8¾	8.67	15	19.48
1⅜	.54	5⅛	3.89	8⅞	8.86	15¼	19.98
1½	.62	5¼	4.03	9	9.05	15½	20.47
1⅝	.69	5⅜	4.18	9⅛	9.23	15¾	20.97
1¾	.77	5½	4.32	9¼	9.42	16	21.47
1⅞	.86	5⅝	4.47	9⅜	9.62	16½	22.47
2	.95	5¾	4.62	9½	9.81	17	23.50
2⅛	1.04	5⅞	4.77	9⅝	10.00	17½	24.54
2¼	1.13	6	4.92	9¾	10.19	18	25.58
2⅜	1.22	6⅛	5.08	9⅞	10.39	18½	26.65
2½	1.32	6¼	5.24	10	10.59	19	27.74
2⅝	1.42	6⅜	5.39	10¼	10.99	19½	28.83
2¾	1.52	6½	5.54	10½	11.30	20	29.95
2⅞	1.63	6⅝	5.71	10¾	11.80	20½	31.07
3	1.74	6¾	5.87	11	12.22	21	32.21
3⅛	1.86	6⅞	6.04	11¼	12.65	21½	33.36
3¼	1.97	7	6.20	11½	13.06	22	34.52
3⅜	2.08	7⅛	6.37	11¾	13.50	22½	35.70
3½	2.19	7¼	6.53	12	13.94	23	36.90
3⅝	2.31	7⅜	6.70	12¼	14.38	23½	38.10
3¾	2.43	7½	6.87	12½	14.82	24	39.32

CAPACITY OF CISTERNS AND TANKS,

in Gallons, for Each Twelve Inches in Depth.

(A. R. Wolff.)

Diameter in Feet.	Gallons.	Diameter in Feet.	Gallons.	Diameter in Feet.	Gallons.
1.0	5.87	6.5	248.23	11.0	710.90
2.0	23.50	7.0	287.88	11.0	777.05
2.5	36.72	7.5	330.48	12.0	846.03
3.0	52.88	8.0	376.00	13.0	992.91
3.5	71.97	8.5	424.48	14.0	1151.54
4.0	94.00	9.0	475.89	15.0	1321.92
4.5	118.87	9.5	530.24	20.0	2350.08
5.0	146.88	10.0	587.52	25.0	3672.00
5.5	177.72	10.5	647.74	30.0	5287.68
6.0	211.51				

Capacity of Cisterns in Barrels, Per Foot in Depth.

(HALL.)

Square Cistern.	Barrels.	Circular Cistern.	Barrels.
5 feet by 5 feet holds........	5.92	5 feet in diameter holds.....	4.66
6 " " 6 " "	8.54	6 " " " "	8.54
7 " " 7 " "	11.63	7 " " " "	11.63
8 " " 8 " "	15.19	8 " " " "	15.19
9 " " 9 " "	19.39	9 " " " "	19.39
10 " " 10 " "	23.74	10 " " " "	23.74

ROAD-MAKING. (CAMPBELL.)

Drainage.—Perfect drainage, first of the foundation of the roadbed, secondly of the road surface, are the points in road-making on which too much stress cannot be laid.

The first is accomplished by underdrainage, tile drains being laid at a depth of three or more feet below the surface on each side of the roadbed at the foot of the grade and parallel to it. Care should be taken to fit and settle the tile in the trench so that, when refilling with earth, they will not be displaced. As a rule 2½- to 4-in. tile will be sufficient. The joints should be close, and the grade a true line. Loose joints and an uneven grade allow silt to pass into the tile and remain there, destroying the drain.

Surface drainage is accomplished by open drains on each side of the grade, having sufficient capacity to drain, both the roadbed and the land adjoining. With open drains and with tile drains make and maintain a free outlet to the nearest watercourse. A drain without an outlet is useless.

Crowning the Road.—The graded portion of the road should be wide enough to accommodate the travel upon it, and not greater, the slope being uniform, not heaped in the centre. The crown should be well above the overflow of storm water, and should have a grade sufficient to shed water readily to the open ditches on either side. Do not round it up so as to make the grade steep and dangerous, under the mistaken impression that better drainage will thereby be secured. Nor should it be so low as to allow water to stand upon it in depressions. Under ordinary circumstances one inch or one inch and a half to the foot is

a proper grade; that is, a roadbed twenty-six feet wide should be from thirteen to twenty inches higher at the center than at the side.

Quality of Gravel.—The gravel should preferably be sharp, clean, and of uniform size. Pit gravel usually contains too much earthy matter, and where the latter is in excess, the gravel, as a road-making material, is useless. Lake gravel is apt to be rounded, water-worn, and lacking in the necessary earthy matter to make a solid and compact surface, but is generally a better road material than pit gravel. A coating of pit gravel with a surfacing of creek gravel is a good combination. All large stones should be removed, as they will work to the surface, and will then roll loosely or form rough protuberances.

Placing the Gravel.—The gravel should be spread evenly over the surface of the sub-grade to a depth of six or eight inches, and to the required width, then rolled with a heavy roller. Rolling should be performed in showery weather, as it is impossible to consolidate dry earth or gravel. The heavier the roller the better will be the results, but if a heavy roller cannot be obtained, a light roller is much better than none. The roller should be passed over the surface until the gravel or earth is so compact as not to be displaced and rutted by the wheels of a wagon passing over it with an ordinary load. The surface must be maintained smooth and hard, to shed water and resist wear. Every municipality should have a roller, but whether one can be obtained or not the gravel should not be left in a heap just as it falls from the wagon. Spread it evenly.

Repairs.—Gravel roads already constructed will need repair. By the use of road machinery, scrape the surface and cut off the corners, which will have formed at the foot of the grade by the washing down of dusty material from the crown of the road. Loosen the surface, particularly that part of the traveled portion and where the road is rutted, with picks, or, if possible, with road machinery ; then apply a coating of gravel, and roll thoroughly. It is of more importance, however, to see that the drains are not obstructed in their course and that their outlets are free and open.

IMPORTANCE OF GOOD ROADS.

It is estimated that it costs a farmer more to haul a bushel of wheat than it does a railroad to haul a ton ; that our poor roads cost the farmer at least $15.00 a year for every horse, and that good earth roads would save more than half the cost of hauling, and good permanent roads more than three quarters of it. (GILMORE.)

Force Required to Draw a Load on Different Kinds of Roads.

	Force Required to Draw a Gross Load of 2240 Pounds.	Steepest Grade (rise per 100 ft.) on which Vehicle will not Roll Back.	Draught on a Level Compared with that on Different Grades. Rise in feet per 100 feet.					
			0	3	6	9	12	15
	Pounds	Feet						
Earth road.......	200	8.9	1	1.3	1.7	2.0	2.3	2.7
Gravel "	143½	6.4	1	1.5	1.9	2.4	2.9	3.3
Macadam road...	65	2.9	1	2.0	3.1	4.1	5.1	6.1
Telford " ...	46	2.0	1	2.5	3.9	5.4	6.8	8.2
Plank " ...	41	1.8	1	2.6	4.3	5.9	7.5	9.1
Stone trackway..	12½	.5	1	6.4	11.7	17.1	22.3	27.5

TRACTIVE FORCE REQUIRED FOR CARRIAGES of one ton, on a level road. (McCONNELL.)

Description of Road.	Force of Traction per Ton.
1. On rails	8 lbs.
2. Well-made pavement..........................	33 "
3. Macadamized road	44 to 67 "
4. Turnpike, hard and dry	68 "
5. " dirty	88 "
6. Hard compact loam..........................	119 "
7. Gravel......................................	150 "
8. Sandy and gravelly	210 "
9. Ordinary by-road................................	237 "
10. Turnpike, newly-gravelled	320 "
11. Loose sandy road	457 "

A horse produces his greatest mechanical effect in drawing a load 2½ miles per hour with a tractive force of 150 lbs.

FRACTION OF THE WEIGHT OF A VEHICLE AND LOAD REQUIRED TO MOVE SAME ON A LEVEL ROAD. (MORIN.)

Character of the Road.	Character of the Vehicle.					
	2-wheeled Carts.	Trucks, 4-wheeled, 3- and 4-horse.	4-horse Stage-coaches, on Springs.		2-horse Carriages, Body on Springs.	
Firm soil, covered with gravel 4 to 6 inches deep..........	$\frac{1}{12}$	$\frac{1}{9}$	$\frac{1}{8}$		$\frac{1}{8}$	
Firm embankment, covered with gravel $1\frac{1}{4}$ to $1\frac{1}{2}$ inch. deep.	$\frac{1}{16}$	$\frac{1}{11}$	$\frac{1}{10}$		$\frac{1}{10}$	
Earth embankment, in very good condition..............	$\frac{1}{41}$	$\frac{1}{29}$	$\frac{1}{26}$		$\frac{1}{26}$	
Bridge flooring of thick oak plank	$\frac{1}{70}$	$\frac{1}{46}$	$\frac{1}{14}$		$\frac{1}{42}$	
Broken-stone Road:			Walk.	Trot.	Walk.	Trot.
In very good condition, very dry, compact and even......	$\frac{1}{75}$	$\frac{1}{54}$	$\frac{1}{48}$	$\frac{1}{41}$	$\frac{1}{49}$	$\frac{1}{42}$
A little moist or a little dusty..	$\frac{1}{53}$	$\frac{1}{38}$	$\frac{1}{34}$	$\frac{1}{27}$	$\frac{1}{34}$	$\frac{1}{27}$
Firm, but with ruts and mud.	$\frac{1}{33}$	$\frac{1}{24}$	$\frac{1}{21}$	$\frac{1}{18}$	$\frac{1}{22}$	$\frac{1}{19}$
Very bad, ruts 4 to $4\frac{1}{2}$ inches deep, thick mud.............	$\frac{1}{19}$	$\frac{1}{14}$	$\frac{1}{12}$	$\frac{1}{10}$	$\frac{1}{12}$	$\frac{1}{10}$
Good pavement, dry..	$\frac{1}{90}$	$\frac{1}{65}$	$\frac{1}{57}$	$\frac{1}{38}$	$\frac{1}{59}$	$\frac{1}{39}$
" " covered with mud.........	$\frac{1}{69}$	$\frac{1}{50}$	$\frac{1}{44}$	$\frac{1}{33}$	$\frac{1}{45}$	$\frac{1}{34}$

DRAUGHT OF HORSES.

At 8 hours per day, $2\frac{1}{2}$ miles per hour, and tractive force of 150 lbs.:

On level hard road.............................. 3 tons
On inferior or hilly road......................... 1 "
On rails... 16 "
On a canal .... 60 to 90 "
Lifting over a pulley.............................. 110 "
Carrying on his back.............................. 300 lbs.

LABOR ONE HORSE IS ABLE TO PERFORM at different rates of speed on canals, railroads, and turnpikes. (Drawing force, $83\frac{1}{3}$ lbs.) (WARING.)

Speed per Hour, miles.	Duration of Day's Work, hours.	Useful Effect for 1 Day, drawn 1 mile.		
		On a Canal, tons.	On a Railroad, tons.	On a Turnpike, tons.
2½	11½	520	115	14
3	8	243	92	12
3½	6	154	82	10
4	4½	102	72	9
5	2 9/10	52	57	7.3
6	2	30	48	6
7	1½	19	41	5
8	1⅛	12.8	36	4.5
9	9/10	9	32	4
10	¾	6.5	28.8	3.6

PERFORMANCE OF ONE TEAM AND PLOUGH IN A DAY, IN ACRES AND TENTHS. (WARING.)

Width of furrows in inches.	Acres.	Width of furrows in inches.	Acres.	Width of furrows in feet.	Acres.	Width of furrows in feet.	Acres.
5	1.0	12	2.4	2	4.8	5½	13.2
6	1.2	14	2.8	2½	6.0	6	14.4
7	1.4	16	3.2	3	7.2	6½	15.6
8	1.6	18	3.6	3½	8.4	7	16.8
9	1.8	20	4.0	4	9.6	7½	18.0
10	2.0	22	4.4	4½	10.8	8	19.2
11	2.2			5	12.0		

THE EFFECT OF WIDE WAGON-TIRES.

The effect of wide and narrow tires for wagons is well illustrated by the following results of carefully conducted experiments by the Studebaker Wagon Co., West Bend, Ind. In the trials given in the second column $1\frac{1}{2}$-inch tires had been substituted for 4-inch tires. (Agr. of Pa., 1894.)

	Width of Tires.	
	4 inches.	$1\frac{1}{2}$ inches.
	lbs.	lbs.
Weight of wagon and load	4345	4235
Draft to start load on block pavement	350	300
Draft to move load at a dead pull on block pavement	100	75
Draft to start load on good hard, sandy road	700	725
Draft to move load at a dead pull on good hard, sandy road	275	300
Draft to start load on good level gravel road	600	650
Draft to move load at a dead pull on good level gravel road	175	175
Draft to start load on muddy road	800	900
Draft to move load at a dead pull on muddy road	550	500

AVERAGE QUANTITY OF STONE REQUIRED PER YEAR TO KEEP 10 FEET OF ROAD, WIDTH = 20 FEET, IN REPAIR. (HERSCHEL.)

	Cub. ft.	Cub. yds.
1. Good material and heavy travel	15–20	= .55– .74
2. Good material and medium amount of travel	10–15	= .37– .55
3. Good material and light travel	5–10	= .18– .37
4. Medium material and heavy travel	20–25	= .74– .92
5. Medium material and medium amount of travel	15–20	= .55– .74
6. Medium material and light travel	10–15	= .37– .55
7. Third-rate material and heavy travel	25–30	= .92–1.10
8. Third-rate material and medium amount of travel	20–25	= .74– .92
9. Third-rate material and light travel	15–20	= .55– .74

INTERIOR DIMENSIONS OF FARM BUILDINGS.

(McConnell.)

	Length.	Breadth.	Height.
	ft.	ft.	ft.
Barn	40	20	20
" (straw)	60	20	20
Cattle feeding-boxes, double	10	20	8
" " " single	10	10	8
Cattle-sheds, for each animal	5	15	8
Cart-sheds, etc., each arch	8	20	10
Cow-stable, for each cow, double	4	30	10
" " " " " single	4	20	10
Dairy	20	20	10
Fold-yards, for each animal	5	30	6
Granary	30	20	8
Hospital	18	18	9
Manure-house	18	18	8
Pigsties, for each 3 animals	6	10	8
Poultry-house	18	18	9
Root-house	20	20	10
Stable, for each horse	6.5	18	10
Workshop	18	18	9
General dimensions of other apartments	....	18	9

6½ ft. allowed to the length of the stable for each horse in it and 7 or 8 ft. for every pair of cows in cow-stable. Horses must each have 1200 cu. ft. of space, and cattle 800 cu. ft., where stalled in stables. Cattle-boxes to be sunk 2 ft. below surface and raised by a dwarf wall 1 ft. above. Cattle-folds and sheds should have a length of 5 ft. for every animal they are intended to contain; when covered, 150 sq. ft. allowed to every head. The pigsties have small open areas attached to each.

XII. HUMAN FOODS.

COMPOSITION OF HUMAN FOOD MATERIALS.*
(ATWATER.)

Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of—

Refuse.—As the bones of meat and fish, shells of shellfish, skin of potatoes, bran of wheat, etc.

Edible Portion.—As the flesh of meat and fish, the white and yolk of eggs, wheat flour, etc. The edible portion consists of *water* and *nutritive ingredients* or *nutrients.*

The principal kinds of nutritive ingredients are *protein, fats, carbohydrates,* and *mineral matters.*

The water, refuse, and salt of salted meat and fish are called non-nutrients. In comparing the values of different food materials for nourishment they are left out of account.

Classes of Nutrients.—The following are familiar examples of compounds of each of the four principal classes of nutrients

PROTEIN.
- *Proteids.*
  - *Albuminoids*, e.g., albumen (white of eggs); casein (curd) of milk; myosin, the basis of muscle (lean meat); gluten of wheat, etc.
  - *Gelatinoids*, e.g., collagen of tendons; ossein of bones; which yield gelatin or glue, etc.
- Meats and fish contain very small quantities of so-called "extractives." They include kreatin and allied compounds, and are the chief ingredients of beef-tea and meat-extract. They contain nitrogen, and hence are commonly classed with protein.

Fats, e.g., fat of meat; fat (butter) of milk; olive-oil; oil of corn, wheat, etc.

Carbohydrates, e.g., sugar, starch, cellulose (woody fiber), etc.

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* Extracts from "Foods, Nutritive Value and Cost" (Farmers' Bulletin No. 23), and "Food and Diet" (U. S. Dept. of Agriculture Year book, 1894).

Mineral matters, e.g., phosphate of lime, sodium chlorid (common salt), etc.

The Fuel Value of Food.—Heat and muscular power are forms of force or energy. The energy is developed as the food is consumed in the body. It is measured in the laboratory by means of an apparatus called the calorimeter. The unit commonly used is the calorie, the amount of heat which would raise the temperature of a pound of water four degrees Fahrenheit.

Taking ordinary food materials as they come, the following general estimate has been made for the average amount of heat and energy in 1 pound of each of the classes of nutrients:

	Calories.
In 1 pound of protein	1,860
In 1 pound of fats	4,220
In 1 pound of carbohydrates	1,860

In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over two pounds of either would be required to equal a pound of the fat of meat or butter or the body fat.

Ways in which Food is Used in the Body.—Food supplies the wants of the body in several ways. It either—

Is used to form the tissues and fluids of the body;

Is used to repair the wastes of tissues;

Is stored in the body for future consumption;

Is consumed as fuel, its potential energy being transformed into heat or muscular energy, or other forms of energy required by the body; or,

In being consumed protects tissues or other food from consumption.

Uses of the Different Classes of Nutrients.—Protein forms tissue (muscle, tendon, etc., and fat) and serves as fuel.

Fats form fatty tissue (not muscle, etc.) and serve as fuel.

Carbohydrates are transformed into fat and serve as fuel.

All nutrients yield energy in form of heat and muscular strength.

In being themselves burned to yield energy the nutrients protect each other from being consumed. The protein and fats of body tissue are used like those of food. An important use of the carbohydrates and fats is to protect protein (muscle, etc.) from consumption.

Definition of Food and Food Economy.—The views thus presented lead to the following definitions: (1) Food is that which, taken into the body, builds tissues or yields energy; (2) the most healthful food is that which is best fitted to the wants of the user; (3) the cheapest food is that which furnishes the largest amount of nutriment at the least cost; (4) the best food is that which is both most healthful and cheapest.

We have, then, to consider the kinds and amounts of nutrients in different food materials, their digestibility, and the kinds and amounts needed for nourishment by people doing different kinds of work.

In general, the animal foods have the most of protein and fats, while the vegetable foods are rich in the carbohydrates, starch, and sugar. The lean meats and fish abound in protein. Cheese has so large a quantity of protein because it contains the casein of the milk. Among the vegetable foods, beans and peas have a high proportion of protein. The proportion in oatmeal is also large. In wheat it is moderate, and in corn meal it is rather small. The materials with the highest fuel value are those with the most fat, because the fuel value of the fat is, weight for weight, two and one-fourth times as great as that of either sugar, starch, or protein. Hence fat pork and butter lead the other materials in fuel value. The fat meats in general stand high in this respect. So also do the grains, flour, and meal, as they have large quantities of carbohydrates. Potatoes are quite low in the list in respect to fuel value as well as protein, principally because they are three-fourths water. For the same reason, milk, which is seven-eighths water, ranks low in respect to both protein and fuel value.

Dietaries and Dietary Standards.—As the outcome of a great deal of observation and experiment, nearly all in Europe, standards have been proposed for the amounts of nutrients and energy in the daily food required by different classes of people. Those of Prof. Voit, of Munich, Germany, are most commonly accepted by specialists in Europe. Voit's standard for a laboring man at moderately hard muscular work calls for about 0.25 pound of protein and quantities of carbohydrates and fats sufficient, with the protein, to yield 3050 calories of energy. Taking into account the more active life in the United States, and the fact that well-nourished people of the working classes here eat more and do more work than in Europe, and in the belief that ample nourishment is necessary for doing the most and the best work, I have ventured to suggest a standard with 0.28 pound of protein and 3500 calories of energy for the man at moderate muscular work. (For list of dietary standards, see p. 155.)

Calculation of Daily Dietaries.—Due regard for health, strength, and purse requires that food shall supply enough protein to build tissue and enough fats and carbohydrates for fuel, and that it shall not be needlessly expensive.

On the basis of the standards for dietaries given on page 155, various combinations of food materials for daily dietaries may be made by calculations from the table, showing percentages of nutrients, etc., in food materials (p. 149). Thus if a dietary for a man at moderately hard muscular work is to be made up of round beefsteak, butter, potatoes, and bread, it may be calculated as follows:

		Protein.	Calories.
		Pounds.	
Round steak.........	1 pound contains.........	.18	855
Butter..............	1 pound contains.........	.01	3,615
Potatoes............	1 pound contains.........	.019	325
Wheat bread........	1 pound contains.........	.088	1,280
Round steak.........	13 ounces contain.........	.14	695
Butter..............	3 ounces contain.........	....	680
Potatoes............	6 ounces contain.........	.02	320
Wheat bread......	22 ounces contain.........	.12	1,760
	Total.................	.28	3,455
	Standard for man at moderate muscular work....	.28	3,500

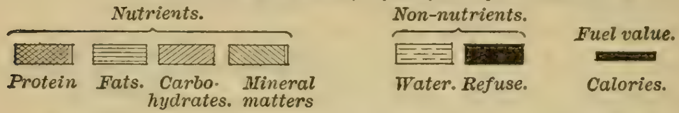
PERCENTAGES OF NUTRIENTS, WATER, AND REFUSE IN SPECIMENS OF FOOD MATERIALS.

(ATWATER.)

Food Materials.	Refuse (Bones, Skin, Shell, etc.).	Edible Portion.					
		Water.	Nutrients.				
			Total.	Protein.	Fat.	Carbo-hydrates.	Mineral Matters.
Animal Foods, as Purchased.	%	%	%	%	%	%	%
Beef: Neck	20.0	49.6	30.4	15.6	14.0	......	0.8
Shoulder	12.6	55.8	31.6	17.0	13.7	......	0.9
Chuck rib	14.6	49.5	35.9	15.0	20.1	......	0.8
Rib	21.0	38.2	40.8	12.2	27.9	......	0.7
Sirloin	19.5	48.3	32.2	15.0	16.4	......	0.8
Round steak	7.8	60.9	31.3	18.0	12.3	......	1.0
Side without kidney fat	19.2	44.3	36.5	13.9	21.8	......	0.8
Rump, corned	5.0	70.8	24.2	16.7	5.1	......	2.4
Flank, corned	12.1	43.7	44.2	12.4	29.2	......	2.6
Veal: Shoulder	17.9	56.7	25.4	16.6	7.9	......	0.9
Mutton: Shoulder	16.3	49.0	34.7	15.1	18.8	......	0.8
Leg	18.1	50.6	31.3	15.0	15.6	......	0.7
Loin	15.8	41.5	42.7	12.6	29.5	......	0.6
Side, without kidney fat	17.3	44.2	38.5	15.0	23.7	......	0.8
Pork: Shoulder roast, fresh	14.6	43.0	42.4	13.6	28.0	......	0.8
Ham, salted, smoked	11.4	36.8	51.8	14.8	34.6	......	2.4
Chicken	38.2	44.6	17.2	15.1	1.2	......	0.9
Turkey	32.4	44.7	22.9	16.1	5.9	......	0.9
Eggs, in shell	13.7	63.1	23.2	12.1	10.2	......	0.9
Fish, etc.: Flounder, whole	66.8	27.2	6.0	5.2	0.3	......	0.5
Bluefish, dressed	48.6	43.0	11.1	9.8	0.6	......	0.7
Codfish, dressed	29.9	58.5	11.6	10.6	0.2	......	0.8
Shad, whole	50.1	35.2	14.7	9.2	4.8	......	0.7
Mackerel, whole	44.8	40.4	15.0	10.0	4.3	......	0.7
Halibut, dressed	17.7	61.9	20.4	15.1	4.4	......	0.9
Salmon, whole	35.3	40.6	24.1	14.3	8.8	......	1.0
Salt codfish	42.1	40.5	17.6	16.0	0.4	......	1.2
Smoked herring	50.9	19.2	29.9	20.2	8.8	......	0.9
Salt mackerel	40.4	28.1	31.5	14.7	15.1	......	1.7
Canned salmon	4.9	59.3	35.8	19.3	15.3	......	1.2
Lobsters	62.1	31.0	6.9	5.5	0.7	0.1	0.6
Oysters	82.3	15.4	2.3	1.1	0.2	0.6	0.4
Animal Foods, Edible Portion.							
Beef: Neck	......	62.0	38.0	19.5	17.5	......	1.0
Shoulder	......	63.9	36.1	19.5	15.6	......	1.0
Chuck rib	......	58.0	42.0	17.6	23.5	......	0.9
Rib	......	48.1	51.9	15.4	35.6	......	0.9
Sirloin	......	60.0	40.0	18.5	20.5	......	1.0
Round	......	68.2	31.8	20.5	10.1	......	1.2
Side, without kidney fat	......	54.8	45.2	17.2	27.1	......	0.9
Rump, corned	......	58.1	41.9	13.3	26.6	......	2.0
Flank, "	......	49.8	50.2	14.2	33.0	......	3.0
Veal: Shoulder	......	68.8	31.2	20.2	9.8	......	1.2
Mutton: Shoulder	......	58.6	41.4	18.1	22.4	......	0.9
Leg	......	61.8	38.2	18.3	19.0	......	0.9
Loin	......	49.3	50.7	15.0	35.0	......	0.7

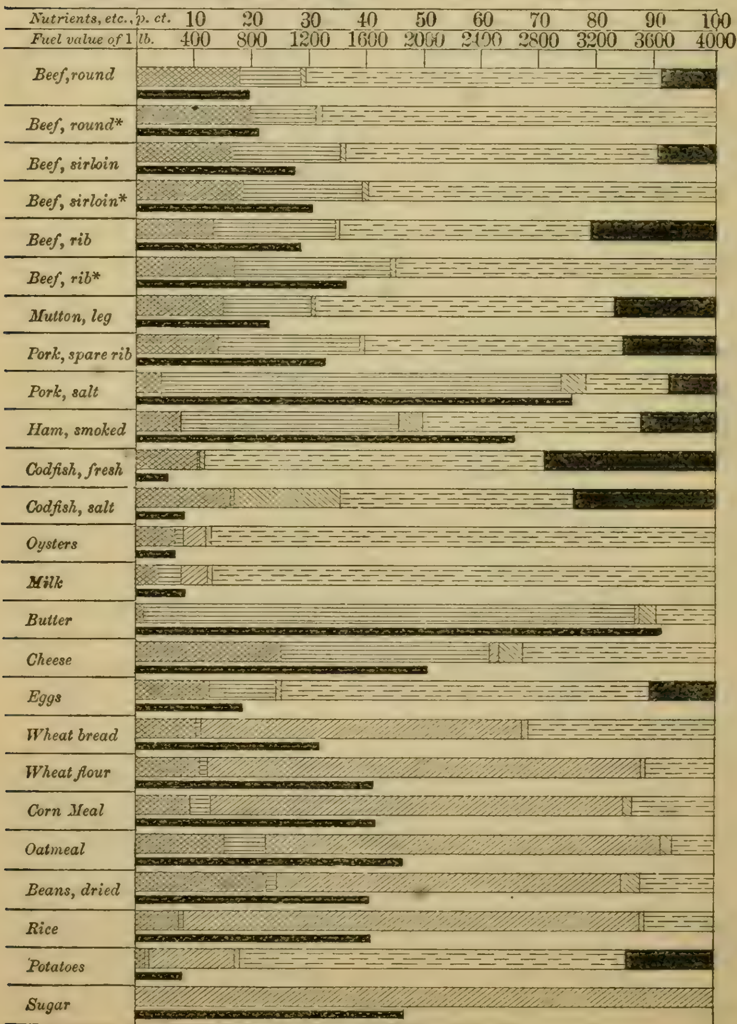
COMPOSITION OF FOOD MATERIALS.

Nutritive ingredients, refuse, and fuel value.



Protein compounds, e. g., lean of meat, white of egg, casein (curd) of milk, and gluten of wheat, make muscle, blood, bone, etc.

Fats, e. g., fat of meat, butter, and oil, } serve as fuel to yield heat
Carbohydrates, e. g., starch and sugar, } and muscular power.



* *Without bone.*

PERCENTAGES OF NUTRIENTS, ETC., IN FOOD MATERIALS.—*Continued.*

Food Materials.	Edible Portion.					
	Water.	Nutrients.				Mineral Matters
		Total.	Protein.	Fat.	Carbo-hydr.	
Animal Foods, Edible Portion.	%	%	%	%	%	%
Mutton: Side, without kidney fat..	53.5	46.5	16.9	28.7	......	0.9
Pork: Shoulder roast, fresh........	50.3	49.7	16.0	32.8	......	0.9
Ham, salted, smoked........	41.5	58.5	16.7	39.1	......	2.7
Fat, salted	12.1	87.9	0.9	82.8	......	4.2
Sausage: Pork.....................	41.2	58.8	13.8	42.8	......	2.2
Bologna..................	62.4	37.6	18.8	15.8	......	3.0
Chicken..........................	72.2	27.8	24.4	2.0	... ..	1.4
Turkey...	66.2	33.8	23.9	8.7	......	1.2
Eggs............	73.8	26.2	14.9	10.5	.....	0.8
Milk.............................	87.0	13.0	3.6	4.0	4.7	0.7
Butter...........................	10.5	89.0	1.0	85.0	0.5	3.0
Oleomargarine....................	11.0	89.5	0.6	85.0	0.4	3.0
Cheese: Full-cream...............	30.2	69.8	28.3	35.5	1.8	4.2
Skim-milk...........	41.3	58.7	38.4	6.8	8.9	4.6
Fish: Flounder...................	84.2	15.8	13.8	0.7	......	1.3
Haddock....................	81.7	18.3	16.8	0.3	......	1.2
Codfish.....................	82.6	17.4	15.8	0.4	......	1.2
Shad........................	70.6	29.4	18.6	9.5	......	1.3
Mackerel....	73.4	26.6	18.2	7.1	.....	1.3
Halibut.....................	75.4	24.6	18.3	5.2	......	1.1
Salmon......................	63.6	36.4	21.6	13.4	......	1.4
Salt cod....................	53.6	......	21.4	0.3	......	1.6
Herring, salt...............	34.6	.. ...	36.4	15.8	.....	1.5
Mackerel, salt.....	43.4	......	17.3	26.4	......	2.6
Oysters	87.1	12.9	6.0	1.2	3.7	2.0
Vegetable Foods.						
Wheat flour....	12.5	87.5	11.0	1.1	74.9	0.5
Graham flour (wheat)........... ...	13.1	86.9	11.7	1.7	71.7	1.8
Rye flour...........................	13.1	86.9	6.7	0.8	78.7	0.7
Buckwheat flour....................	14.6	85.4	6.9	1.4	76.1	1.0
Oatmeal............................	7.6	92.4	15.1	7.1	68.2	2.0
Cornmeal...........................	15.0	85.0	9.2	3.8	70.6	1.4
Rice	12.4	87.6	7.4	0.4	79.4	0.4
Peas.....................	12.3	87.7	26.7	1.7	56.4	2 9
Beans	12.6	87.4	23.1	2.0	59.2	3.1
Potatoes...........................	78.9	21.1	2.1	0.1	17.9	1.0
Sweet potatoes.....................	71.1	28.9	1.5	0.4	26.0	1.0
Turnips............................	89.4	10.6	1.2	0.2	8.2	1.0
Carrots............................	88.6	11.4	1.1	0.4	8.9	1.0
Onions..	87.6	12.4	1.4	0.3	10.1	0.6
String beans.....................	87.2	12.8	2.2	0.4	9.4	0.8
Green peas....	78.1	21.9	4.4	0.6	16.0	0.9
Green corn	81.3	18.7	2.8	1.1	13.2	0.6
Tomatoes...........................	96.0	4.0	0.8	0.4	2.5	0.3
Cabbage........	91.9	8.1	2.1	0.3	5.5	1.1
Apples.............................	83.2	16.8	0.2	0.4	15.9	0.3
Sugar, granulated..................	2.0	98.0	......	....	97.8	0.2
Molasses...........................	24.6	75.4	......	....	73.1	2.3
White bread (wheat)................	32.3	67.7	8.8	1.7	56.3	0.9
Boston crackers....................	8.3	91.7	10.7	9.9	68.7	2.4

PECUNIARY ECONOMY OF FOOD.

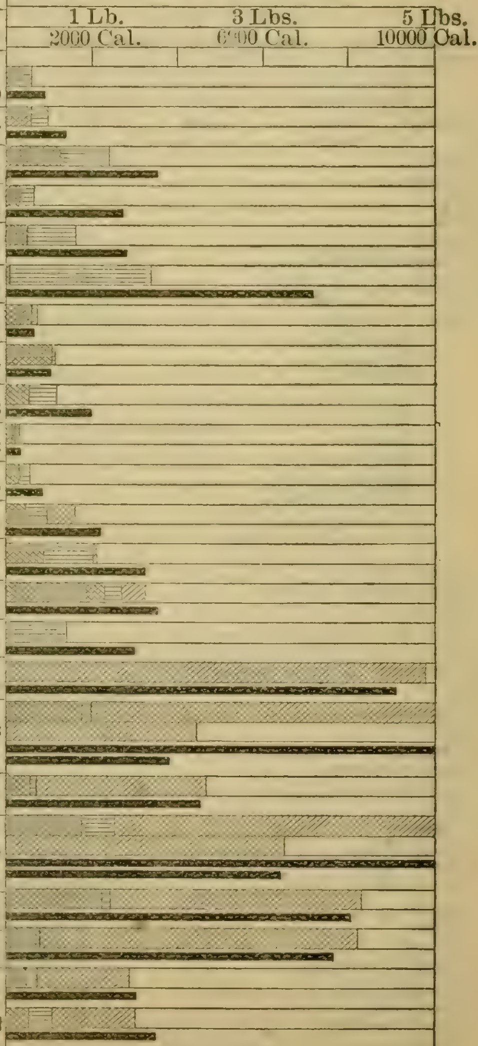
Amounts of actually nutritive ingredients obtained in different food materials for 25 cents.

[Amount of nutrients in pounds. Fuel value in calories.]

Protein. Fats. Carbohydrates. Fuel value.

	Price per pound.	Food materials for 25 cents.
	Cts.	*Lbs.*
Beef, sirloin	25.0	1.00
Beef, round	15.0	1.67
Beef, neck	6.0	4.17
Mutton, leg	22.0	1.14
Ham, smoked	16.0	1.56
Salt pork, very fat	12.0	2.08
Codfish, fresh	8.0	3.13
Codfish, salt	7.0	3.57
Mackerel, salt	12.0	2.08
Oysters, 35 cents quart	18.0	1.43
Eggs, 25 cents dozen	14.7	1.70
Milk, 7 cents quart	3.5	7.14
Cheese, whole milk	15.0	1.67
Cheese, skim milk	8.0	3.13
Butter	30.0	0.83
Sugar	5.0	5.00
Wheat flour	3.0	8.33
Wheat bread	7.0	3.57
Corn meal	2.5	10.00
Beans	5.0	5.00
Potatoes	1.2	20.00
Standard for daily diet for man at moderate work.	*German.**	
	American.†	

Weights of nutrients and calories of energy in 25 cents worth.



*Voit †Atwater.

AMOUNTS OF NUTRIENTS FURNISHED FOR TWENTY-FIVE CENTS IN FOOD MATERIALS AT ORDINARY PRICES. (ATWATER.)

Food Materials as Furnished.	Prices per Pound.	Twenty-five Cents will pay for					
		Total Food Materials.	Nutrients.				Calories of Potential Energy.
			Total.	Protein	Fats.	Carbo-hydr.	
	cts.	lbs.	lbs.	lbs.	lbs.	lbs.	cals.
Meats, etc.							
Beef: Neck.	8	3.13	.95	.49	.44	......	2765
	6	4.17	1.27	.65	.58	......	3655
Chuck-ribs.	16	1.56	.56	.23	.31	......	1735
	12	2.08	.75	.31	.42	......	2350
Ribs.	22	1.14	.47	.14	.32	......	1610
	18	1.39	.57	.17	.39	......	1960
Shoulder.	14	1.79	.57	.30	.25	......	1615
	10	2.50	.79	.43	.34	......	2235
Sirloin.	22	1.14	.37	.17	.19	......	1120
	18	1.39	.45	.21	.23	......	1360
Rump.	18	1.39	.63	.19	.43	......	2170
	15	1.67	.76	.23	.52	......	2620
Round, first cut.	18	1.39	.44	.25	.17	......	1180
	15	1.67	.52	.30	.21	......	1445
Round, second cut.	10	2.50	.52	.35	.15	......	1285
	8	3.13	.65	.44	.18	......	1580
Flank, corned.	15	1.67	.77	.21	.49	......	2460
	10	2.50	1.11	.31	.73	......	3655
Corned and canned.	18	1.39	.66	.37	.24	......	1700
	14	1.79	.85	.48	.31	......	2200
Liver.	8	3.13	.96	.63	.17	.11	2095
Mutton: Shoulder.	20	1.25	.41	.18	.22	......	1265
	15	1.67	.58	.25	.31	......	1775
Leg.	25	1.00	.31	.15	.16	......	955
	20	1.25	.39	.19	.20	......	1195
Loin.	25	1.00	.43	.13	.29	......	1465
	20	1.25	.53	.15	.37	......	1840
Pork: Rib roast.	12	2.08	.88	.28	.58	......	2970
	16	2.50	1.06	.34	.70	......	5885
Smoked ham, whole.	16	1.56	.86	.25	.58	......	2915
	12	2.08	1.08	.31	.72	......	3615
Salt fat pork.	15	1.67	1.17	.02	1.38	......	5860
	12	2.08	1.03	.02	1.72	......	7295
Pork sausage.	15	1.67	.98	.13	.72	......	3465
	12	2.08	1.22	.29	.89	......	4295
Poultry, etc.: Chicken.	22	1.14	.32	.28	.02	......	605
	16	1.56	.45	.38	.03	......	835
Turkey.	23	1.09	.37	.26	.09	......	865
	18	1.38	.47	.32	.12	......	1100
Fish, etc.							
Mackerel, whole.	18	1.39	.22	.14	.06	......	515
	15	1.67	.25	.17	.07	......	610
	10	2.50	.37	.25	.11	......	930
Bluefish, dressed.	15	1.67	.19	.16	.01	......	340
	10	2.50	.28	.25	.02	......	550
Cod, dressed.	10	2.50	.28	.25	.01	......	505
	8	3.13	.36	.33	.01	......	655
	6	4.17	.48	.44	.01	......	860

AMOUNTS OF NUTRIENTS FURNISHED FOR TWENTY-FIVE CENTS IN FOOD MATERIALS AT ORDINARY PRICES.—*Continued.*

Food Materials as Furnished.	Prices per Pound.	Twenty-five Cents will pay for: Total Food Materials.	Nutrients. Total.	Protein	Fats.	Carbo-hydr.	Calories of Potential Energy.
Fish, etc.	cts.	lbs.	lbs.	lbs.	lbs	lbs.	cals.
Halibut steaks	20	1.25	.26	.19	.06	.....	605
	16	1.56	.32	.24	.07	.....	740
Canned salmon	20	1.25	.46	.25	.20	......	1310
Oysters, 50 cts. per quart	25	1.00	.13	.06	.01	.04	230
" 35 " "	17.5	1.43	.18	.09	.02	.05	345
Lobster, whole	12	2.08	.14	.11	.01	......	345
	10	2.50	.17	.14	.02	......	415
" canned	20	1.25	.28	.23	.01	......	470
Eggs and Dairy Products.							
Eggs, 35 cts. per doz	25	1.00	.23	.12	.10	......	645
" 25 " "	18.2	1.37	.32	.17	.14	......	910
" 15 " "	11	2.27	.53	.28	.23	......	1490
Milk, 8 cts. per quart	4	6.25	.81	.23	.25	.29	2020
" 6 " "	3	8.33	1.08	.30	.33	.39	2675
" 4 " "	2	12.50	1.63	.40	.50	.59	4065
Butter	35	.71	.64	.01	.60	......	2550
Cheese, full cream	25	1.00	.90	.01	.85	.01	3635
	18	1.38	.96	.40	.49	.02	3850
	12	2.08	1.45	.50	.72	.04	4210
Vegetable Foods.							
Potatoes, $1.00 per bushel	1.7	14.70	.31	.03	.01	.26	580
" .80 "	1.25	20.00	.42	.04	.02	.36	790
" .50 "	0.85	29.40	.62	.06	.03	.53	1225
Sweet potatoes	5	5.00	.14	.00	.00	.13	240
	3	8.33	.24	.01	.00	.22	430
Beets	2	12.50	.14	.02	.00	.11	240
	1	25.00	.29	.04	.00	.22	485
Turnips	2	12.50	.13	.02	.00	.10	225
	1	25.00	.27	.03	.01	.21	490
Sugar	5	5.00	4.90	.00	.00	4.89	9095
Dried beans	6	4.17	3.64	.96	.09	2.47	6760
	5	5.00	4.37	1.15	.10	2.96	8065
	4	6.25	5.46	1.44	.13	3.70	11110
Maize "corn" meal	3	8.33	7.08	.77	.32	5.88	13720
	1	25.00	21.25	2.30	.95	17.65	41115
Oatmeal	5	5.00	4.61	.74	.36	3.42	9255
Wheat flour	4	6.25	5.47	.69	.07	4.68	10285
	3.5	7.14	6.25	.79	.08	5.35	11755
	3	8.33	7.29	.92	.09	6.24	13695
Wheat bread	7	3.57	2.42	.31	.06	2.01	4570
	5	5.00	3.38	.44	.09	2.82	6445
Crackers	12	2.08	1.91	.21	.20	1.47	3970
	8	3.13	2.88	.32	.29	2.21	5930

DIETARY STANDARDS. (JAFFA.)

	Protein, Lbs.	Fat, Lbs.	Carbo-hydrates, Lbs.	Fuel Value (Calories).	Nutritive Ratio.
1. Children, 1–2 years (average)	.06	.08	.16	765	1:5.6
2. Children, 2–6 years (average)	.13	.09	.44	1420	5.0
3. Children, 6–15 years (average)	.16	.10	.71	2040	5.2
4. Adult in full health—Playfair	.26	.11	1.17	3140	5.5
5. Active laborers—Playfair	.34	.16	1.25	3630	4.7
6. Man at moderate work—Voit	.26	.12	1.10	3055	5.3
7. Man at hard work—Voit	.32	.22	.99	3370	4.7
8. Man with little physical exercise—Atwater	.20	.20	.66	2450	5.5
9. Man with light muscular work—Atwater	.22	.22	.77	2800	5.7
10. Man with moderate work—Atwater	.28	.28	.99	3520	5.8
11. Man with active work—Atwater	.33	.33	1.10	4060	5.6
12. Man with hard work—Atwater	.39	.55	1.43	5700	6.9
13. Subsistence diet—Playfair	.13	.03	.75	1760	6.3
14. Average of 7 dietaries of professional men, Europe	.25	.22	.63	2670	4.7
15. Average of 5 dietaries of professional men, United States	.27	.34	1.08	3925	6.6

DIAGRAMS OF CUTS OF MEAT.

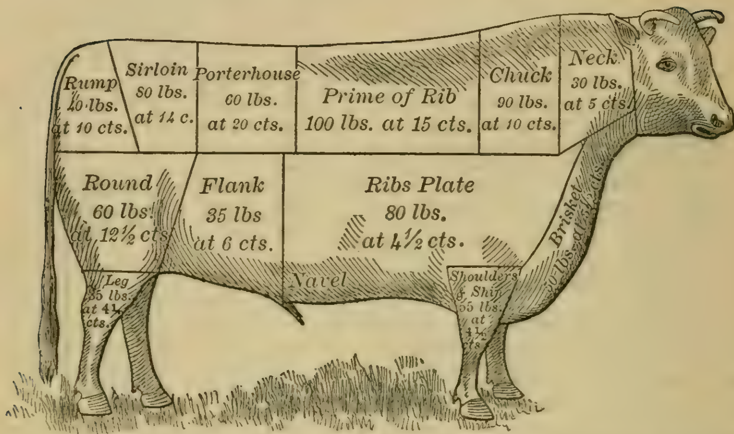
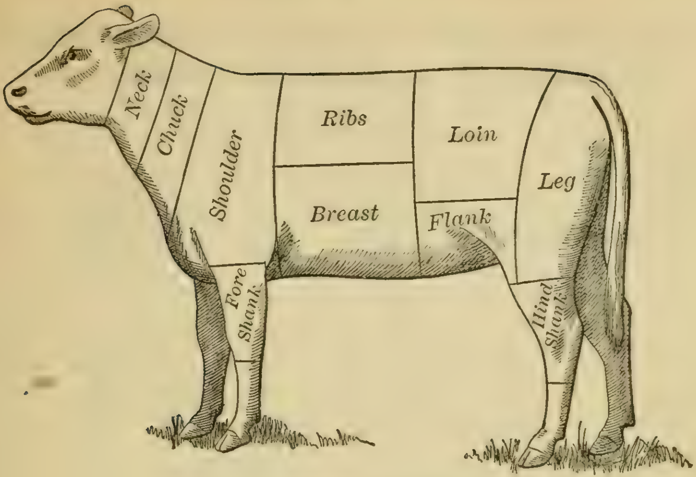


Diagram I. A Good Steer's Carcass, as Cut Up and Priced in the Eastern Market.

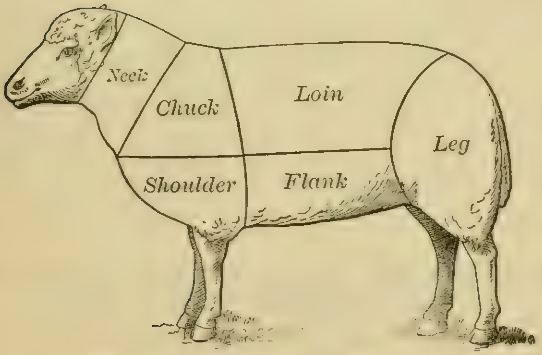
A good 1200-pound steer will dress about 800 pounds of beef cut up as above—715 pounds salable cuts, with 85 pounds of fat, bone, and waste.

The diagram illustrates what the breeder and feeder should aim to produce in the conformation of the beef- and mutton-producing animal, so that the highest possible percentage of the carcass will be cuts of the high-priced class, thereby giving the best possible return for food consumed. (McKerrow.)

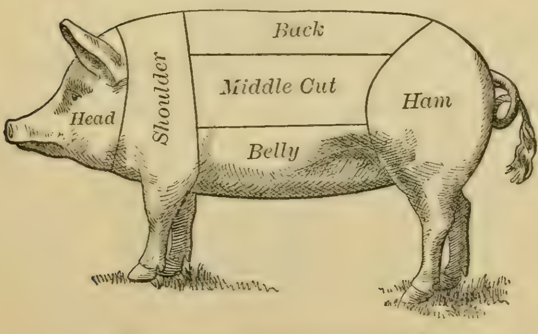
The methods of dividing up the carcasses of slaughtered animals into parts, and the terms used for the "cuts," as these parts are commonly called, vary considerably in different localities. The accompanying diagrams will make clear the terms used in the table Composition of Human Foods (pp. 149–51).



II. Diagram of Cuts of Veal.*



III. Diagram of Cuts of Mutton.*



IV. Diagram of Cuts of Pork.*

* U. S. Dept. of Agriculture.

LIVE WEIGHT AND DRESSED WEIGHT OF STEERS OF DIFFERENT BREEDS AND AGES. (Henry.)

(*Smithfield Show*, 1888–95.)

Breed and Age.	No. of Animals.	Aver. Age.	Aver. Daily Gains.	Live Weight at Slaughtering.	Dressed Weight.
		Days.	Lbs.	Lbs.	Per Ct.
Shorthorn, 1 year olds..	5	642	2.11	1355	66.1
2 " " ..	18	963	1.92	1842	67.5
3 " " ..	16	1321	1.72	2251	69.4
Hereford, 1 " " ..	16	663	1.97	1308	65.1
2 " " ..	13	1020	1.78	1817	67.2
3 " " ..	8	1349	1.64	2218	69.2
Devon, 1 " " ..	13	634	1.75	1112	66.9
2 " " ..	19	1045	1.51	1583	67.7
3 " " .	16	1311	1.37	1796	67 3
Aberdeen Angus, 1 " " ..	26	668	2.04	1366	65.4
2 " " ..	21	1008	1.74	1765	66.7
3 " " ..	2	1346	1.59	2138	67.4
Sussex, 1 " " ..	17	677	2.15	1452	65.4
2 " " ..	18	989	1.86	1837	68.2
3 " " ..	12	1285	1.61	2064	68.0
Red Poll, 2 " " ..	12	1002	1.64	1631	65.7
3 " " ..	6	1362	1.49	2022	65.8
Galloway, 2 " " ..	7	1027	1.64	1688	64.5
3 " " ..	4	1344	1.47	1969	64.8

PROPORTION OF BEEF TO THE LIVE WEIGHT OF CATTLE. (McConnell.)

	Live Weight, Pounds Avoirdupois.	Per Cent of Beef.		
		Class I.	Class II.	Class III.
Heifers	Under 2520	70.72	66.69	....
Steers......................	" 2520	69.71	66.69	....
Steers......................	1680–2100	66.68	63.65	63.66
Heifers....................	1400–1680	66.68	63.65	63.66
Steers......................	1400–1680	62.65	60.62	57.62
Heifers....................	1260–1400	62 65	60.62	57.62
Steers......................	1260–1400	57 61	54.59	51.56
Heifers....................	1120–1260	57.61	54.59	51.56
Steers......................	1120–1260	53.56	50.53	48.50
Heifers....................	980–1120	53.56	50.53	48.50
Heifers....................	Under 980	....	....	45.47

COMPARATIVE RESULTS OBTAINED WITH FATTENING ANIMALS. (Lawes and Gilbert.)

(*a*) *Per* 100 *lbs. live weight per week.*

	Received by Animal.		Results Produced.		
	Total Dry Food.	Digestible Organic Matter.	Food Consumed for Heat and Work.	Dry Manure Produced.	Increase in Live Weight.
	lbs.	lbs.	lbs.	lbs.	lbs.
Oxen	12.5	8.9	6.86	4.56	1.13
Sheep........	16.0	12.3	9.06	5.10	1.76
Pigs..........	27.0	22.0	12.58	4.51	6.43

(*b*) *In relation to food consumed.*

	Increase in Live Weight.		On 100 lbs. of Dry Food.		
	Per 100 lbs. Dry Food.	Per 100 lbs. Digested Organic Matter.	Consumed for Heat and Work.	Dry Manure Produced.	Dry Increase Yielded.
	lbs.	lbs.	lbs.	lbs.	lbs.
Oxen....	9.0	12.7	54.9	36.5	6.2
Sheep........	11.0	14.3	56.6	31.9	8.0
Pigs..	23.8	29.2	46.6	16.7	17.6

LIVE WEIGHT AND GAINS MADE BY SWINE.

(Henry and Sanborn.)

Live Weight.	No. of Animals.	Aver. Live Weight.	Feed Eaten.	Daily Gain Made.	Feed per Lb. of Gain.	Per 100 Lbs. Live Weight.	
						Feed Eaten.	Gain Made.
Lbs.		Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Under 50	59	37.7	2.31	.701	3.30	6.13	1.86
50–100	91	75.5	3.33	.900	3.70	4.41	1.19
100–150	119	126.1	4.29	1.029	4.17	3.40	.82
150-200	138	176.2	6.45	1.123	5.75	3.66	.64
200–250	65	214.1	6.89	1.287	5.35	3.22	.60
250–300	41	266.4	7.64	1.457	5.24	2.87	.55
300–350	12	333.0	6.02	1.352	4.45	1.81	.41
	525						

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE. (Armsby.)

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
Contents of stomach and intestines	18.0%	15.0%	12.0%	7.0%	16.0%	15.0%	14.0%	12.0%	10.0%	7.0%	5.0%
Blood	4.7	4.2	3.9	4.8	3.9	3.9	3.6	3.2	3.2	7.3	3.6
Skin and horns	8.4	7.4	6.0	6.8	9.6	9.3	8.0	7.2	6.5	......	......
Legs to gambrel joint	1.9	1.7	1.6	1.9							
Washed wool	......	......	......	......	5.0	4.7	4.3	4.0	3.6	......	......
Wool dirt	......	......	......	......	4.8	4.5	4.0	3.6	3.2	......	......
Head	2.8	2.7	2.6	4.8	4.6	4.3	3.7	3.2	2.8	...	....
Tongue and gullet	0.6	0.6	0.5							0.5	0.4
Heart	0.4	0.5	0.5	0.6	0.4	0.3	0.4	0.3	0.2	0.5	0.3
Lungs and windpipe	0.7	0.7	0.6	1.2	1.5	1.5	1.2	1.0	1.0	1.4	0.9
Liver and gall-bladder	1.5	1.3	1.3	1.6	1.4	1.3	1.3	1.3	1.0	2.6	1.7
Diaphragm	0.5	0.5	0.5	0.4	0.3	0.3	0.3	0.2	0.2	.....	......
Spleen	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2
Stomach, without contents	4.5	3.0	2.7	1.2	2.4	2.3	2.3	2.0	1.5	1.2	0.7
Intestines, without contents	2.0	1.5	1.4	2.4	2.3	2.2	1.9	1.7	1.3	3.9	2.2
Fat of omentum and intestines	2.3	2.9	4.5	2.4	3.0	4.1	4.9	6.8	8.0	1.7	2.5
Four quarters, including kidneys and kidney fat	47.4	55.7	60.3	60.0	43.3	45.3	49.4	52.8	57.1	72.8	82.1
Loss	4.1	2.1	1.4	4.6	1.3	0.8	0.5	0.1	0.3	0.9	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SUMMARY.											
Blood	4.7	4.2	3.9	4.8	3.9	3.9	3.6	3.2	3.2	7.3	3.0
Skin, head, legs, and tongue	13.7	12.4	10.7	13.5	24.0	22.8	20.0	18.0	16.1	......	.. .
Entrails	9.8	7.7	7.2	7.7	8.5	8.1	7.7	6.6	5.3	9.8	6.0
Flesh and fat	49.7	58.6	64.8	62.4	46.3	49.4	54.3	59.6	65.1	74.5	84.6
Contents of stomach and intestines	18.0	15.0	12.0	7.0	16.0	15.0	14.0	12.0	10.0	7.0	5.0

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE.—*Continued.*

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
CONSTITUENTS OF CARCASS.											
(DRESSED WEIGHT, INCLUDING FAT OF OMENTUM, ETC.)											
Flesh, without fat and bones	36.0%	38.0%	35.0%	43.0%	33.2%	33.5%	33.1%	29.0%	27.%	46.4%	40.0%
Bones	7.4	7.3	7.1	9.3	7.1	6.6	5.9	5.5	5.2	8.0	5.8
Fat in flesh	2.0	7.9	14.7	5.5	2.0	3.3	8.0	14.7	20.5	16.5	32.4
Fat on kidneys	2.0	2.5	3.5	2.2	1.0	1.9	2.4	3.6	4.4	1.9	3.9
Fat on omentum and intestines	2.3	2.9	4.5	2.4	3.0	4.1	4.9	6.8	8.0	1.7	2.5
Total	47.7	58.6	64.8	62.4	46.3	49.4	54.3	59.6	65.1	74.5	84.6
FLESH OF CARCASS WITHOUT FAT AND BONES.											
Dry matter	8.0	8.4	7.5	8.8	6.8	6.7	6.3	5.4	5.1	8.1	7.3
Water	28.0	29.6	27.5	34.2	26.4	26.8	26.8	23.6	21.9	38.3	32.7
Total	36.0	38.0	35.0	43.0	33.2	23.5	33.1	29.0	27.0	46.4	40.0
IN 100 PARTS OF FLESH WITHOUT BONES.											
(BUTCHERS' MEAT.)											
Fat	5.3	17.2	29.4	11.3	5.7	9.0	19.5	33.6	43.2	26.2	45.5
Muscle substance	19.8	17.5	14.5	17.0	18.0	17.1	14.5	11.7	10 2	12.3	9.7
Ash	1.2	0.9	0.8	1.1	1.3	1.1	0.8	0.7	0.6	0.6	0.4
Water	73.7	64.4	55.3	70.6	75.0	72.8	65.2	54.0	46.0	60.9	44.4
Total	100.0	100.0	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0	100.0

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE.—*Continued.*

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
COMPOSITION OF LIVE ANIMALS.											
Fat	7.1%	14.9%	26.8%	13.1%	8.6%	13.2%	18.3%	28.1%	37.2%	22.5%	40.2
Protein	15.8	15.5	13.7	15.3	15.4	14.8	13.8	12.2	10.0	13.9	11.0
Ash	4.8	4.4	3.9	4.5	3.4	3.3	3.2	2.9	2.8	2.7	1.8
Water	54.3	50.2	43.6	60.1	56.6	53.7	50.7	44.8	39.0	53.9	42.0
Contents of stomach and intestines	18.0	15.0	12.0	7.0	16.0	15.0	14.0	12.0	10.0	7.0	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
THE SAME, LESS CONTENTS OF STOMACH AND INTESTINES.											
Fat	8.7	17.5	30.5	14.1	10.2	15.5	21.3	31.9	41.4	24.2	42.3
Protein	19.2	18.3	15.6	16.5	18.3	17.4	16.0	13.9	12.2	15.0	11.9
Ash	5.9	5.2	4.4	4.8	4.0	3.9	3.8	3.3	3.1	2.9	1.9
Water	66.2	59.0	49.5	64.6	67.5	63.2	58.9	50.9	43.3	57.9	43.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MINERAL MATTERS IN 100 PARTS OF LIVE ANIMAL.											
Phosphoric acid	1.92	1.76	1.56	1.64	1.33	1.29	1.25	1.13	1.09	1.10	0.73
Lime	2.14	1.96	1.74	1.93	1.40	1.35	1.31	1.19	1.15	1.15	0.77
Magnesia	0.06	0.06	0.05	0.06	0.05	0.04	0.04	0.04	0.04	0.05	0.03
Potash	0.18	0.16	0.14	0.29	0.16	0.16	0.15	0.14	0.13	0.15	0.10
Soda	0.14	0.13	0.12	0.07	0.15	0.15	0.14	0.13	0.12	0.10	0.07
Silica	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	.....	.....
Sulfuric acid, chlorin, and carbonic acid	0.34	0.32	0.28	0.50	0.29	0.29	0.29	0.25	0.25	0.15	0.10
Total	4.80	4.40	3.90	4.50	3.40	3.30	3.20	2.90	2.80	2.70	1.80

PART II. DAIRYING.

I. DAIRY COWS.

ON THE ORIGIN AND CHARACTERISTICS OF THE DIFFERENT BREEDS OF DAIRY CATTLE.

I. Jersey Cattle.

The origin of the Jersey cattle, like many of our other improved breeds of live-stock, is not known with certainty. The theory is that they descend from cattle brought from the Scandinavian countries to Normandy, France, during the tenth century or before, whence they were introduced into the Island of Jersey, off the French coast. The breed has been kept pure on this little island for a longer period than any other English breeds, as a result of the enactment in 1789 of a law forbidding importations of foreign cattle into the island. According to Flint, Jerseys were first imported into this country about 1838, but heavy importations did not begin until after 1850.

The following is a description of typical Jersey cows: Head fine and tapering; cheek small; throat clean; the muzzle fine and encircled with a slight stripe; the nostril high and open; the horns smooth, crumpled, not very thick at the base, tapering, and tipped with black; ears small and thin, deep orange color inside; eyes full and placid; neck straight and fine; chest broad and deep; barrel hooped, broad and deep, well ribbed up; back straight from the withers to the hip, and from the top of the hip to the setting on of the tail; tail fine, at right angles with the back, and hanging down to the hocks; skin thin, light color, and mellow, covered with fine soft hair; forelegs short, straight and fine below the knee, arm swelling and full above; hind quarters long and well filled; hind legs

short and straight below the hocks, with bones rather fine, squarely placed, and not too close together; hoofs small; udder full in size, in line with the belly, extending well up behind; teats of medium size, squarely placed and wide apart, milk veins very prominent; color is generally cream, dun, or yellow, with more or less white.

The Jerseys are generally considered a butter-producing breed, and justly so. The milk produced is as a rule richer in fat and solids than that of any other breed, but the quantity yielded, on the other hand, is apt to be lower. Milk from good Jersey cows often contains over six per cent of fat, the average being about five per cent. Production of rich milk has been the primary aim of Jersey breeders; in 1881 the secretary of the American Jersey Cattle Club wrote: "The sole office of the Jersey cow is to produce the largest possible amount of rich, highly colored cream from a given amount of food. Everything else in connection with the breeding of the race is, or should be, incidental."

The highest yields of butter-fat or butter, in case of Jersey cows as well as other dairy breeds, are not, however, apt to come from cows producing exceptionally rich milk, but rather from such producing an exceptionally large quantity of good milk; generally speaking, an extraordinarily high fat-content is accompanied by a small milk yield.

Typical Jerseys generally have a high-strung, nervous temperament, and in order to do their best must receive good care; they cannot be abused as to feed or treatment without injury; for this reason they will only prove a success in the hands of intelligent feeders who care for and take an interest in their stock. The dairy type predominates, viz.: a wedge-shaped, deep-chested body, with good digestive organs, large full udders, well-developed milk-veins, and a soft, mellow skin. The cows are gentle and docile, while the bulls have the reputation of being hard to handle, and often ugly and dangerous after a couple of years' service.

The maximum yields of milk and butter produced by Jersey cows are given on page 189, the table giving the

official records. In the breed-tests conducted by the experiment stations in Maine, New Jersey, and New York (Geneva), the Jerseys have ranked among the first, but have seldom been the foremost. As the average of all tests of dairy breeds up to date, we notice that the Jerseys rank after the Shorthorns and the Guernseys in total yield of fat during a full period of lactation, and after Guernseys in the cost of producing one pound of fat; they rank first as to richness of milk produced. In the English milking trials conducted by the British Dairy Farmers' Association, the Shorthorn cows have generally led the Jerseys in the total quantities of fat produced per day, and other breeds have also, on the average, given better results than these. The Jerseys came out victorious in the breed-tests conducted at the World's Columbian Exposition in 1893; they produced more milk, butter-fat, butter, and cheese, and gave a higher net gain than either of the two other breeds competing (Guernsey and Shorthorn); the Guernseys, on the other hand, led as regards the cost of the food consumed. In the breed-test No. 1 ("the fifteen-day cheese test") Ida Marigold, 32615, produced the largest quantity of cheese, viz.: 70.92 lbs., and Merry Maiden, 69449, the largest quantity of butter-fat, viz.: 30.73 lbs. In breed-test No. 2 ("the ninety-day test") Brown Bessie, 74997, produced 178.12 lbs. of butter-fat, Merry Maiden and Ida Marigold following, with 164.81 lbs. and 164.28 lbs., respectively.

The American Jersey Cattle Club was organized in July 1868; the *Herd Register* of the club, the first volume of which was published in 1871, has been issued in forty-five volumes up to date, including in all 42,000 bulls and 109,000 cows. *Butter Tests of Registered Jersey Cows* gives all tests of registered Jerseys where the yield of butter for seven consecutive days was 14 lbs. or more; the latest volume published is Vol. II., New Series.

The present secretary of the American Jersey Cattle Club is J. J. Hemingway, No. 8 W. Seventeenth St., New York City.

II. Guernsey Cattle.

By Prof. W. H. Caldwell, Peterboro, N. H., Sec'y Am. Guernsey Cattle Club.

The Guernsey breed takes its name from the Island of Guernsey, one of the Channel, or sometimes termed Alderney, Islands. The origin of the Channel Island cattle, while somewhat involved in controversy, is generally believed to have come from stock originally from the French provinces of Normandy and Brittany, and that the foundation for the Guernseys was laid by crossing the Normandy bull on the Brittany cow. It is very interesting to turn to the Island of Guernsey, cut off as it is from the main land by the little strip of sea, and protected on all sides by a rough, rocky coast, and note the characteristics which we find there that have played so important a part in moulding the character of the Guernsey of to-day. There the shrewd, careful, sturdy people have labored many years to produce a cow that should excel in butter production. Their labors have been rewarded in the Guernsey, which is noted the world over for producing butter of the highest natural color and with the least outlay for cost of feed. Fate might have been different with these people but for their insular situation, pride of self-government, habits and customs, which led them to zealously fight invasions, and even as early as 1789 to take measures against the fraudulent importation of stock. In 1826 came more stringent laws, that prohibited importation to the island except for slaughter. It thus isolated the islanders and their cows from the cattle kingdom.

The striking appearance of the Guernsey is at once seen in its rich yellow skin, which has always been noted as the characteristic of a good butter-cow. In appearance they are rangy, deep, business-looking animals, with a particularly quiet, gentle, tractable temperament, free from nervousness. The prevailing color is a delicate shade of fawn with white markings, and cream-colored nose; and their most remarkable characteristic of richness is apparent in the

golden color around the eye, on the udder and teats, at base of horn, and at end of the bone of tail.

Until recently Guernseys in America were kept chiefly for family use. They were introduced into private dairies around Philadelphia as early as 1840, and since that time no other breeds have been permitted to replace them. The gentlemen who first introduced Guernseys had no motive to advertise them. They esteemed their golden-colored products so highly that they were kept for the supplying of families with the best milk and butter that could be produced. About 1865 a few Guernseys were introduced by the importers, which laid the foundation of some of our herds of to-day. A few years later the Massachusetts Society for the Promotion of Agriculture, realizing the great promise of the breed, imported some and distributed them at a public sale to dairymen in the State. A few years later a number of Connecticut farmers joined together and sent a man to the island to bring over a lot. It soon became obvious to these gentlemen that some organization was necessary to preserve the purity of these cattle and to encourage their recognition. Accordingly on February 7, 1877, the American Guernsey Cattle Club was organized in New York City. At that time there were about one hundred and fifty pure-bred Guernseys in the country, whose pedigrees could be traced without question to importation from the island. At present there are about 14,000 animals in the Register. In the last few years—in fact since the World's Fair Dairy tests in 1893, and the work at the New York and New Jersey Experiment Stations—great interest has been taken in the Guernseys. More entries and transfers have been recorded, and more members have joined the Club than at any similar period in its history. The public are just realizing the straightforward work that has been quietly done for the last quarter of a century, and find in a study of it that there are many valuable records to the credit of the breed. These are all the more valuable as the Guernsey has not been forced for high records, but have honestly won their way.

The best records reported of Guernseys are those of Lily

of Alexandre, No. 1059, and Imp. Bretonne, No. 3660. Lily of Alexandre gave 12,855½ pounds of milk in one year; and two months before calving tested 7.2 per cent of butter-fat. Bretonne gave in the year ending October 20, 1894, 11,219 pounds of milk. Her milk was tested carefully once a month by taking a composite sample of eight consecutive milkings. The lowest test was 5.2 per cent and highest 6.1 per cent butter-fat. Her milk yielded $602\frac{91}{100}$ pounds of butter-fat, or equivalent to $753\frac{5}{10}$ pounds of butter containing 80 per cent butter-fat. She is a large, well-built cow, and weighed at the close of her year's work 1150 pounds. In addition the cow Fantine 2d, No. 3730, owned by Mr. Chas. Solveson of Nashotah, Wis., gave in one year, besides dropping a fine calf and being dry four weeks, 9748 pounds of milk, the lowest test being 5 and the highest 5.6 per cent butter-fat, which would yield a year's record of 516.6 pounds butter fat or 602 pounds of butter. Mr. Ezra Michener of Carversville, Pa., owns the cow King's Myra, No. 5339, who has just completed the year's test under the direction of the Guernsey Breeders' Association and received their first prize. She is four years old, and gave in the year 8611 pounds of milk, which yielded 539 pounds of butter. Nearly a hundred cows have been reported that have made a record of 14 pounds or over of butter a week, and several that have made exceedingly fine single-day tests, as one cow, Pretty Dairymaid 2d of Guernsey, No. 6366, who in an official test gave in three consecutive days 61 pounds 2 ounces, 62 pounds 12 ounces, and 52 pounds and 9 ounces of milk, a total of 176 pounds 7 ounces.

The irability to produce butter-fat and butter at a low cost demands the careful attention of the dairymen. At the New York Experiment Station several of the dairy breeds are being carefully tested. The annual report of the director, which was recently issued, gives the result of the first two periods of lactation. In both instances the Guernseys produced butter-fat at the least cost, as the following shows:

COST OF BUTTER-FAT PER POUND.

	1st Period.	2d Period.
Guernsey	18.4 cts.	15.6 cts.
Jersey	20.0 "	18.5 "
Devon	23.0 "	19.0 "
Ayrshire	24.3 "	24.8 "
Am. Holderness	26.3 "	22.8 "
Holstein-Friesian	26.3 "	26.4 "

This agrees with the work done at the New Jersey Experiment Station and with the average results of the butter tests at the World's Fair.

COST PER POUND OF BUTTER PRODUCED.

	New Jersey.	World's Fair.
Guernsey	15.3 cts.	13.1 cts.
Jersey	17.9 "	13.3 "
Ayrshire	20.6 "	....
Shorthorn	20.8 "	15.8 "
Holstein	22.4 "	....

This shows the Guernseys to be the most economical producers of butter; and such golden-yellow butter, too!

The American dairyman, in his endeavor to improve his own herd and collectively to improve the herds of his section, naturally takes a great deal of interest in the grade dairy cow. In the progressive dairy sections the influence which pure-bred bulls exert is readily acknowledged. They intensify the good qualities of the breed to which they belong, and make such a section a desirable place for the seeking of good family and profitable dairy cows. The value of the Guernsey bull in effecting this improvement has been well understood for many years, and especially is it realized to-day in the desire to secure in the dairy cattle of America greater physical strength and more profitable butter production without reducing size or sacrificing richness of milk production. Mr. Lewis F. Allen, in his writings several years ago, spoke especially of his experience with the Guernsey for grading. He said his experience was good, large-sized animals, free and persistent milkers, and

the making of the first quality butter for private family or hotel use. He believed that on a whole the Guernseys were more satisfactory for the dairy than any which in his forty years' experience he had ever had. His cows had good square udders, well set front and behind, teats of good size and easy to grasp.

The Herd Register is published by the American Guernsey Cattle Club, whose headquarters are at Peterboro, N. H. The breeders of Guernseys have always been harmonious in letting their favorites win their way by their own straightforward efforts in the dairy. By addressing the Secretary of the Club at Peterboro, N. H., further information will cheerfully be furnished.

III. Holstein-Friesian Cattle.

By S. Hoxie, Yorkville, N. Y., Supt. Advanced Registry Holstein-Friesian Association of America.

This is our American representative of the Lowland race, native to the low, rich lands of Belgium, Holland, and Northern Germany. Its origin is ascribed to the Friesians—a tribe of people mentioned by Roman historians before the opening of the Christian era as peaceable cattle-breeders dwelling on the shores of the North Sea. The present dairy farmers of the provinces of North Holland and Friesland are the lineal descendants of those cattle-breeders, and they are to-day handling the same race upon the same lands. These farmers are the leading dairymen of Europe. As evidence of this, Chambers' Encyclopedia* gives the export of butter from the province of Friesland to England in 1874 as 266,041 cwt. The number of cows owned in that province in 1879 was 144,802. Assuming the same number in 1874, this export averages 205¾ lbs. per cow; assuming the same number of acres of grass lands, this export averages 117⅛ lbs. per acre. No data of home consumption or of exports to other countries are given. These combined must have been large, and, were they added, would much increase these averages. Lest

* Edinburgh and London edition, article "Friesland."

some reader may assume that a part of this enormous export must have been oleomargarine or artificial butter, it is well to add here that no such products were known in Friesland at that date.

According to U. S. Consular reports on Cattle and Dairy Farming, the amount of butter imported from Holland into Great Britain in 1877 was 41,679,085 lbs. in 1884, of cheese, 65,994,544 lbs. The import of butter for 1877 rather than for 1884 is quoted, because the former date was "before oleomargarine had become an industry in that country."* There is no question that nearly all these imports were from the two provinces, North Holland and Friesland. The country we call Holland is composed of eleven provinces with a total area of 12,597 sq. miles. The total area of North Holland and Friesland is 2303 sq. miles. To get the significance of the above statistics, let them be compared with the total imports, to the same common market, from the United States and Canada. These in 1884 were, of butter 17,440,416 lbs., and of cheese, 109,333,280 lbs. So far as this breed of cattle is concerned, it is safe to let the reader draw his own conclusions.

As to the characteristics of this breed the most important is indicated by the above statistics. To the casual observer the color may appear the more striking. This is variegated in distinct markings. The American herd-books receive only black-and-white to entry. The European herd-books receive red-and-white, gray-and-white, and mouse-colored-and-white; but the great bulk of their entries are black-and white. The structure of this breed is also an important characteristic. This is best shown by measurements. The average measurements of all the full-age cows (those five years old and upwards) received to the fourth volume of the Holstein-Friesian Advanced Register were as follows: Height at shoulders, 51.8 + inches; at hips, 53; length of body, 64.9 + ; of rump, 21.4 — ; width of hips, 21.9 —, at thurl, 19.6 + ; girth at smallest circumference of chest, 75.6 +. These are fairly representative of the breed, and describe what is technically called the milk-and-beef form.

* U. S. Consular Reports [1886]—Cattle and Dairy Farming, p. 15.

There are animals of the breed of other forms, but they must be regarded as exceptional in this respect. The average weight of these cows was 1262 + lbs. This is also fairly representative of the breed. Rapidity of growth and earliness of maturity are alike characteristics of the breed. This may also be shown by measurements. Taking the entries in one of the European herd-books, we find, from actual measurements reported, that heifers reach their full height at between two and a half and three years old, that each year for the following two years they increase one and three fourths inches in length of body, two inches in girth of chest, and three-fourths of an inch in width of hips. After five years old no increase is shown except what may be properly ascribed to additions of flesh. Another characteristic is constitutional vigor. No dairy breed probably excels it in this. It enables the breed to resist disease, to endure climatic changes, and its cows to endure forcing to enormous productions. In the reign of Peter the Great, importations of this breed were made into Northern Russia, into the district of Kolmogory, within three and a half degrees of the Arctic Circle. Other importations to the same district have since been made. All appear to have acclimated without difficulty. Crossed on the nondescript native cattle of that district they have produced a numerous progeny called the Kolmogory breed, "remarkable for its yield of milk."*

Every breed has limited adaptations. A breed valuable in one section may not be valuable in another that differs in soil, lay of territory, and wants of its inhabitants. The adaptations of this breed make it specially valuable on rich soils, level lands, and in densely populated districts, where every product—milk, butter, cheese, beef, and veal—can be utilized. In view of these facts, the merits of a breed may properly be measured by its distribution—by its aggressiveness. Judged by this standard, we find that this breed is the exclusive breed of North Holland and Friesland, "more esteemed than any other in Belgium;"† "furnishing

* U. S. Consular Reports [1886]—Cattle and Dairy Farming, p. 519.

† The same, p. 367.

the best and most prolific milch cows in Germany;"* crossed on native cattle, the "favorite in St. Petersburg,"† and used in almost every country of Europe outside of Switzerland and Great Britain. At the present time it is finding place in South Africa, New Zealand, and in some of the states of South America. Its introduction and spread in our own country, within the present generation, is one of the marvels of our day.

IV. Ayrshires.

By C. M. Winslow, Brandon, Vt., Secretary Association of Ayrshire Breeders.

The original home of the Ayrshire cow is in Scotland, in the county of Ayr. This county has always been noted for its dairy industry, and the thrift of its inhabitants. The soil is strong, giving good pasturing and abundant crops, the climate is rough, and people and cattle hardy.

The Ayrshires began to attract the attention of dairymen in other parts of the world some fifty years ago, and there was an importation made into Canada and the New England states, where they are bred in considerable numbers and highly prized. They have been sent South, and are said to endure the heat better than any other breed. They also are said to stand the cold of Canada better than any other dairy breed.

The Ayrshire cow is of medium size, weighing about one thousand pounds, of blocky build, low on legs, and usually spotted in color, being red and white as a rule, though sometimes nearly red. They are hardy and healthy, enduring changes of heat and cold with little discomfort, and quickly adapt themselves to surrounding conditions. They perhaps show to the best advantage where the food supply is limited, and they are compelled to hunt for a full supply.

It is claimed for the cows of this breed that they will give the largest return of dairy product for food consumed of any of the dairy breeds. There has never been much said or done by the owners of Ayrshires to bring their merits to the attention of the public. They are a popular

* U. S. Consular Reports [1886]—Cattle and Dairy Farming, pp. 398, 404.
† The same, p. 519.

cow for the milkman, because they are economical producers and because they give milk of good quality that satisfies the trade.

High-grade Ayrshire cows always command the highest fancy price in Brighton, to go into the stables of milk producers. It is said by the milk inspectors of Boston that they have no trouble with the milk from Ayrshire herds, it being up to the 13 per cent total solids required by Massachusetts law.

The average yield of Ayrshire cows is a little over 6000 lbs. of milk in a year, on ordinary dairy food and care, but there are a large number of individual cows with authenticated records all the way from 7000 lbs. to over 12,000 lbs. of milk in a year. There has never been any attempt made to develop the butter quality of the Ayrshire cow, and but little is known of her ability in this direction; but occasional evidence shows her to be naturally adapted to taking a high stand as a butter maker, if she was desired for that branch of dairying. The following instances of her butter quality will illustrate:

Duchess of Smithfield, owned by Mr. Watson, gave an official record of 19 lbs. 6 oz. of butter in seven days.

Rena Myrtle, a cow sold by the writer to the experiment station at Burlington, Vt., gave them this last year 546 lbs. of butter in 365 days, being the largest butter record they ever made by any cow of any breed. Her milk record for the time was 12,172 lbs.

I might mention other instances, but they are private records.

The Ayrshire, being a dairy cow, has never been claimed for beef or even for a general purpose cow, but her easy keeping qualities and hardy disposition cause her to lay on flesh rapidly when dry, and she will probably return to her owner in beef the full cost of raising her. Farmers who fatten calves for veal tell me the calves are small when born, but grow so rapidly that when of age to sell, are large and heavy for their age and are good handlers.

[Mr. Winslow's herd of Ayrshires averaged during 1895 6765 lbs. of milk; average per cent of fat, 3.85; average

yield of butter fat, 260.5 lbs., or of butter, 303.9 lbs. (see p. 244). In maintaining his herd he adheres to the following requirements:

"Size: About 1000 pounds at maturity, this size having been found to give the best results in this locality, and being of sufficient size to please buyers, either for breeding or to sell in Brighton as milk cows.

"Color: Dark red with white patches—about one-fourth white being preferred. This gives a wonderfully attractive and lively look to a herd of cows, grouped or moving. Then, too, I have thought cows of this color were tougher and gave yellower milk and butter.

"Style: Small head and horns, slim neck, straight back, sharp shoulders, wide on the loin; large, shapely hind quarters; long, slim tail; udder extending well forward and back, well up under belly; teats long, of equal length, well spread; large milk veins.

"Disposition: Quiet and pleasant."—W.]

V. Shorthorns as Dairy Cows.

By J. H. Pickrell, Springfield, Ill., Secretary American Shorthorn Breeders' Association.

Away back in the early history of this country, there were occasionally cows imported from England. Buffalo and wild game were abundant for meat, but milk, butter, and cheese did not come that way.

As creatures of circumstances, cows were in demand. Soon after the Revolutionary War, cattle that were pure-bred Shorthorns were imported into Virginia, and afterwards, in 1797, found their way into Kentucky. The cows were said to be great milkers, and are reported to have given as much as 32 quarts of milk per day, and were called by the natives "the milk breed." Later importations with more particular reference to their beef qualities were made, but, in spite of all that had been fed into them with that end in view, many of the cows developed into remarkably heavy milkers, and were very noted for their large yield of a good quality of milk.

The late L. F. Allen, in his history of "American Cattle," published in 1868, says: "We have numerous well-

authenticated instances of their (Shorthorns) giving six, seven, eight, and even nine gallons a day, on grass alone, in the height of their season, and yielding fourteen to eighteen pounds of butter per week, and of holding out in their milk in proportionate quantity, as well as other breeds of cows, through the year. Cows so much larger in size than other kinds should be expected to give more than smaller ones that consume less food, and without asserting that they do give more, in proportion to their size, it is claimed that when educated and used for the dairy chiefly, they give quite as much as others. That the inherent quality of abundant milking exists in the Shorthorns, no intelligent breeders of them need doubt. Our own observation in more than thirty years' experience with hundreds of them, first and last, under our own eyes, is to ourself evidence of the fact, both in thoroughbreds and grades."

The Columbian dairy tests, though made under unfavorable circumstances, proved the milking qualities of Shorthorns. I say unfavorable, because the matter was not taken hold of soon enough by the American Shorthorn Breeders' Association, under whose auspices the exhibit was made, to select the best cows in every instance so as to have them bred to produce and have them at their highest flow of milk at the proper time. As a consequence, cows had to be picked up that had produced at hap-hazard, and were not in every instance the best that might have been used, if selections had been made in season to have them bred so as to have them produce just prior to the tests. But with all these disadvantages, the two strictly acknowledged dairy breeds—bred for that purpose almost exclusively—which were selected with the greatest care, so much so that it is doubtful whether they could be duplicated, had but little the advantage of the Shorthorns in the general "round-up," as a few comparisons will prove.

In test No. 1 (cheese), with 25 cows of each breed, the score stood as follows:

Jerseys	906.1	points
Shorthorns	905.5	"
Guernseys	871.9	"

In the score for perfection of 100 points flavor was counted 55 points.

Shorthorns headed the list by taking	504.3	points.
Jerseys	497.8	"
Guernseys	489.4	"

The cost of production was:

Shorthorns	$99.36
Jerseys	98.14
Guernseys	76.25

The champion cheese cow of the Jerseys netted	$6.97
" " " " " " Shorthorns netted	6.27
" " " " " " Guernseys "	5.27

In the second test, 90 days, for butter, loss and gain in live weight, where maintenance was counted against the cows, the net gain was for

Jerseys (25 cows)	$1,323.81
Guernseys (25 cows)	997.63
Shorthorns (24 cows)	911.13

To produce this result it cost the

Jerseys (25)	$587.87
Shorthorns (24)	506.50
Guernseys (25)	487.25

The champion

Shorthorn cow (Nora)	produced	3679.8	lbs. of milk.
Jersey (Brown Bessie)	"	3634	" " "
Guernsey (Materna)	"	3548.8	" " "

When reduced to gain in the products over cost of production, the account stood as follows:

Jersey cow	$73.22
Guernsey cow	57.82
Shorthorn cow	52.63

Again, in tests 2, 3, and 4 (Guernseys were not in test No. 4) the three best Shorthorns (one in each test, including the two-year-old heifer) gave...... 5861 lbs.
While the Jerseys of the same description gave.. 5330 "

Showing in favor of Shorthorns.................. 531 "

In test No. 3 (butter), "go as you please,"

The champion Jersey cow at a cost of $8.57 produced net	$24.69
The champion Shorthorn cow at a cost of $8.18 produced net	19.57
The champion Guernsey cow at a cost of $5.57 produced net	$19.37
In test No. 4 (heifers) 7 Jerseys cost for food $34.43 and netted	56.27
6 Shorthorns cost $23.52 and netted	47.42

making an average of 13 cents per head in favor of the Jerseys.

While butter was rated by points, beef was not, and the Jerseys got as much allowance per pound for gain in live weight as the Shorthorns.

As hinted above, dairy cows are not always wanted for butter alone, or cheese alone, but very frequently to supply city customers with good milk for their tables. The tests at the Columbian Dairy School proved that for a large supply of milk of the best flavor, Shorthorns not only were good dairy cows in every sense of the term, but that they led the other two breeds. Therefore, if milk of good quality and lots of it is wanted, Shorthorn cows can supply it, to say nothing of their "general-use" qualities that will just suit the farmer who wants milk, butter, cheese, and beef.

VI. Red Polled Cattle.

By J. McLain Smith, Dayton, Ohio, Secretary Red Polled Cattle Club of America.

Hornless or polled cattle have existed in the counties of Norfolk and Suffolk, England, from time immemorial. Originally there were two distinct types: the Suffolks, usually of a pale red or dun color, and hence known as Suffolk duns—large and rather rough cattle, but celebrated for their milking qualities; and the Norfolks, commonly deep red in color, smaller, finer, more compact in build, not so large milkers, but great favorites with the butcher.

Youatt, speaking of the old Suffolk strain as it existed in his day (some half century ago), says: "In the height of the season some of these cows will give as much as eight gallons of milk (80 lbs.) in a day, and six gallons (60 lbs.) is not an unusual quantity."

The mödern Red Polled cow is a result of the combination of these old strains, and it is the aim of the most progressive breeders to produce a cow of medium size, blood-red in color, of fine bone, smooth and compact of form, hardy, docile, fatting easily, and giving a good flow of fairly rich milk all the year round. The breed, in other words, is being developed as a general farm cow, suited to the wants of the general farmer. While the cows cannot, I think, compete in flow of milk with the best Holsteins, or in yield of butter with the best Jerseys, and the steers have not, as yet, taken a place in the front rank at the fat-stock shows, it is believed that the breed combines the several desirable traits as well at least as any other, and with them the equally essential qualities of hardiness, docility, and a hornless head. As an illustration of the points named, and a proof of their possible combination, the cow No. 2213, Gleaner, V, 9, is credited in 1894, according to the accepted record of the owner, with a yield of 14,189 lbs. of milk, an average of 38 86 lbs. a day for the entire year. The cow was then twelve years old, and was milking with her tenth calf (or tenth calving, as one or more of them produced twins).

Among these is a pair of twins (Freemartins), shown as fat stock, at Norwich and London, England. The steer (1st and cup at Norfolk and 1st at Smithfield) weighed at 1 year 5¼ months old, 1238 lbs., and when shown again, at 2 years 6 months old, had a live weight of 1735 lbs., a gain in a few days over a year of 497 lbs., and a gain from birth of about 2.12 lbs. a day. The heifer, twin to above (1st and reserve for cup at Norfolk and 1st and reserve for cup at Smithfield), had a live weight when shown (2 years 6 months old) of 1452 lbs., a gain from birth of nearly 1.8 lbs. a day.

An illustration nearer home is reported by Dr. J. R. Slingerland, Trustee of the Shaker Society at Union Village, O. In January, 1895, he bought 35 head of Shorthorn steers, coming 2 years old, for feeding. At the same time they had 18 head, the same age, of their own breeding, the produce of a Red Polled bull on Shorthorn cows. At the time named the full-blood Shorthorns averaged 940 lbs. in weight, and the cross-breds 790 lbs. All were pastured the summer of 1895, fed out in the late fall, and sold to the same buyer on the same day in January, 1896.

The full-blood steers consumed an average of 85 bushels of corn, besides hay and corn-fodder, in fatting, and weighed when sold an average of 1540 lbs. each—a gain of 600 lbs. in the year. They sold for $4 a hundred. The polled cross-breds consumed an average of 50 bushels of corn, with corn-fodder only for roughage, and weighed when sold an average of 1492 lbs.—a gain in the year of 702 lbs. They sold for $4.25 a hundred.

The Red Polled bull, Osman 1251, used in producing the cross-bred steers in this trial, is the son of a full sister to Eleanor, and is the sire of many fine dairy cows.

In appearance the Red Polls greatly resemble Devons, save the horns, and except that they are somewhat larger, and the cows, as a rule, are better milkers. They have the same rich color, fine bone, round, smooth, compact form, free from prominent points, and the same muscular habit and active disposition; and their meat is of the same fine-grained, juicy character.

Milking Qualities.—The modern Red Polled cow does not milk so largely as the old Suffolk, but her milk is of better quality. Sixty pounds a day, which Youatt says in his time was not unusual, is now, I think, somewhat rare. Four and a half to five gallons a day, or say 40 to 45 lbs., is a good yield from a mature cow in the flush of the season. But she will easily give, with proper care, 6000 to 8000 lbs. in a year, and some will considerably exceed this. In the report of English herds, published in the Red Polled Herd Book, the average yields of mature cows in the best herds is from 5000 to over 7000 lbs. a year. In Lord Rothchild's

herd, 22 cows, seven milking with first or second calf, gave in 1895 an average of 7744½ lbs. of milk each. In my own little herd the mature cows will average over 6000 lbs. of milk a year and 4 per cent of fat.

Beef Qualities.—In this line, so far, we are entirely dependent for facts on the English records. No full-blood steers of the breed have as yet been shown in this country. A few samples will suffice. At the Smithfield Club Show in 1889, two Red Polled steers, two years old, showed the largest daily gain of anything on exhibition that old—2.18 lbs. and 2.29 lbs., respectively. At the Smithfield Club Show of 1890 a Red Polled steer dressed the highest per cent of his live weight of any animal slaughtered—73.72 per cent. This, according to the London *Live Stock Journal*, has only once been exceeded in England—by a cross-bred steer, which dressed 74 per cent of his live weight.

At the fat-stock shows in England in 1894 the following live weights were recorded: A steer 1 year 10½ months, 1374 lbs., and a year later 1702 lbs.; a steer 1 year 10¼ months, 1323 lbs.; a steer 1 year 10½ months, 1208 lbs., and a year later 1656 lbs.; a steer 1 year 9 months, 1250 lbs., a year later 1728 lbs., and at 3 years 9 months 2112 lbs.

Mature Red Polled cows, in breeding condition, should weigh 1200 to 1400 lbs., and bulls 1800 to 2000 lbs. A few will greatly exceed these weights, but many, as now bred, are smaller. These, however, are about the weights attained in the best herds.

VII. Devon Cattle.

By L. P. Sisson, Wheeling, W. Va., Secretary American Devon Cattle Club.

The Devon breed of cattle is one of the oldest of the English cattle. Their native home is on the highlands of Devonshire, in southwestern England. Our records show that in the year 1800 Messrs. Winthrop & Davenport imported Devons into Plymouth, Mass.; in 1805 General Eaton imported some into Otsego county, New York; in 1817 Mr. George Patterson came into possession of some Devons, brought over by T. W. Coke, who presented them to a

brother of George Patterson; these afterward were the foundation of the above-mentioned herd (George Patterson of Sykesville, Md.). These and other animals imported by Mr. Patterson, our records show, were all brought from Devonshire, and from the best that could be found there.

Others were imported into New York State; among importers whom we might mention are John Cowlin of Truxton, N. J.; L. F. Allen, Miles Vernon, A. Becket, W. P. & C. S. Wainwright, Col. L. G. Morris, D. W. Catlin, W. R. Sanford, J. Howard McHenry of Pikesville, Md.; C. P. Halcomb of Delaware, and others. Later importations are by James Murray of Virginia, R. W. Cameron of New York, Frank Brown of Baltimore, Md., and still later John Hudson, Moweaqua, Ill., Dr. J. Cheston Morris, Philadelphia, Pa., and A. S. Worden, Ulysses, Pa.

As to the beef qualities of the Devons one only has to turn to the records of the markets of the country to see that they are among the leading beefers, bringing the top prices at all times. As to milk and butter production from Devons, it will be found from records that they produce from 12 to 25 lbs. of butter per week. Mr. A. E. Baker, of Wisconsin, says his cows average him 365 lbs. of butter per cow for the year, which is about as much as any breed will do on farmers' feed and care. Dr. J. Cheston Morris says, in regard to Devons for milk: "A herd of Devons may be relied upon to give an annual yield of 2000 quarts of milk from each cow; the length of the period averages between 10 and 11 months, though single cows will continue in profit from 13 to 14 months. An average yield of seven quarts daily from each cow may therefore be expected, and an examination of milk records of Devon herds will show that they are remarkably uniform in their yields. As comparatively little attention has been paid to their milking qualities, a large improvement may be looked for by proper selection and breeding. As my animals weigh only 700 lbs. each, it follows that each cow has given between five and six times her own weight in milk during the course of the year, besides maintaining her own

weight, and producing healthy offspring. This I consider a physiological fact well worthy of notice, and very creditable to the 'little red cow.' Of course the same nutritive power applied in other directions would give beef-producing results, such as we all know of."

Devon cattle are active and very hardy, qualities that make them especially valuable in dry or mountainous regions. The bulls are quite intelligent and active, and are not as liable to be cross as some other breeds; they weigh from 1800 to 2000 lbs. at three to four years old. The cows have strong vital organs, and large digestive and assimilating powers. Their udders are not large for the amount of milk they give, with good elastic teats, seldom sore. The milk is of good quality, either as food for infants and invalids, for the manufacture of butter or cheese, or for market delivery; it does not churn in the cans, nor look blue in the bottle.

Devons will pay their way at the dairy as well as in the feeder's stable; they will keep in good condition, and look plump and sleek on pasture that other breeds can hardly live on; they are easy keepers, good producers of the finest kind of milk, and also make the very best quality of beef.

VIII. Dutch Belted Cattle.

By H. B. Richards, Easton, Penna., Secretary Dutch Belted Cattle Association of America.

Dutch belted cattle are natives of Holland, and originated in that country during the seventeenth century, when the cattle interests of Holland were in the most thrifty condition; in fact, it was the chief industry of the country. At that time breeding had been developed to a science, and cattle of remarkable contrast of color were bred whose foundation color was black, with a broad white band around the centre of the body, a white head, a black ring around each eye, and a full white tail. Wonderful and remarkable as it may appear, a feat was accomplished during that period that would defy our modern breeders and can be safely classified as a lost art.

Dutch belted cattle became a classified breed and were

bred to a remarkably high standard. For several centuries they were owned and controlled by the nobility keeping them pure and limiting their number to their ownership. They were first imported into this country about the middle of the present century, the importers procuring the finest herds in Holland; the herds in the United States to-day are purely of American breeding.

The American Association have adopted as their standard of color a pure black, with a continuous white belt around their body, beginning behind the shoulders and extending nearly to the hips; this sharp contrast of colors makes a beautiful and imposing contrast and a most beautiful sight; when seen in number grazing on the green, they are admired by all, even if not interested in cattle or farming. This belt is almost invariably reproduced, and is so perfectly fixed that it will crop out in their grades for many generations, even against cold strains of blood; the potency of this feature is very striking, as the belt is often reproduced after the foundation color is lost; and grades of any foundation color can be produced to an unlimited extent.

Their form is a strong characterized dairy type, medium size, and possessing all the qualifications of an ideal dairy animal. They are strictly a dairy breed, and are large and persistent milkers; strong constitutions, peaceable and quiet dispositions of a very compact form. Cows range from eight to twelve hundred, and bulls reach eighteen to twenty hundred. The late P. T. Barnum, the showman of national fame, said: "They struck my fancy in Holland about 1850; I imported a few, and then found their unique and novel appearance not their only quality, for they proved to be wonderful milkers, far superior to any other cattle to which my attention has been drawn."

Nearly all the herds now in the United States are owned in New York, Pennsylvania, and Massachusetts, with a few scattering South and West. A herd of eighteen were exhibited at the World's Columbian Exposition at Chicago, where they attracted great attention and were admired by thousands who had never heard of such novel and beautiful

cattle before. This herd was sold and exported to a wealthy resident of the City of Mexico, where they are now kept and are doing well in that congenial climate. There is an association of breeders of these cattle known as the Dutch Belted Cattle Association of America, who have adopted a high standard of excellence, requiring breeders to breed typical animals of correct markings, thereby gaining uniformity and correctness of type. The association issues a herd-book, of which vol. 4, of recent issue, is the last number.

IX. Brown-Swiss Cattle.

By N. S. Fish, Groton, Conn., Secretary Brown-Swiss Cattle Breeders' Association.

Brown-Swiss cattle were first imported into this country by Mr. Henry M. Clarke of Belmont, Mass., in 1869. He imported seven cows and one bull; since then there have been several importations. Most of the animals have come from the famed Canton of Schwyz, and the adjacent Cantons of Zug, Uri, and Unterwalden. The Rigi mountains, covered to their tops with fine, rich herbage, lie here, and some of the finest breeds of cattle in the whole country are here produced, the cattle grazing in the valley in winter and on the mountains in summer.

The United States consul at Zurich in 1882 made a report to our government of the cattle and dairy interest of Switzerland. He writes: "For a hundred years Switzerland has been famous for the production of its dairies. At the cattle show of Paris, 1878, every Swiss cow exhibited bore away a prize in competition with exhibits from Holland, England, Denmark, and other famous cattle countries.

The Brown-Swiss cattle are fed on grass or hay only the year through. A fair average for cows in Canton Zurich is ten quarts of milk per day the milking-year through; in Schwyz and Zug the average is but little less."

The consul of St. Gall says: "When a farmer in Germany, Italy, or France wishes to improve his breed, he

makes a selection from Swiss herds as the healthiest and hardiest known to the herd-book. . . . The Brown-Swiss is considered the dairy breed *par excellence* of Switzerland; it not only gives more milk, but this is richer than any other European breed of cattle."

Marked Characteristics.—Size large; form firm; color shades from dark to light chestnut brown. The tuft of hair between the horns, on the inside of ear, and a narrow line along the back generally light. Horns rather short, waxey, with black tips. Nose black, with mealy-colored band surrounding nose. Switch, hoofs, and tongue black. Straight hind legs, wide thighs, and heavy quarters. The cows often weigh 1600 lbs., bulls 2000 lbs. Calves large, some weighing 110 lbs. when dropped. They mature fast, have healthy constitutions, yielding generous returns for whatever care, time, labor, or money is expended on them.

A cow shown at the Fat Stock Show in November, 1891, gave in three days 245 lbs. of milk, showing 9.32 lbs. of butter-fat by the Babcock test, yielding during one day of the test 3¼ lbs. of fat, the largest amount of butter-fat ever shown at an official test of any cow of any breed up to that time. The cow Muotta calved about November 1, 1893, and in February, 1894, gave 67 lbs. of milk in one day.

The milk of Brown-Swiss cows has a sweet flavor which is very noticeable, and makes it very desirable for family use. With good farm care the cows give under favorable circumstances from 20 to 25 quarts of milk per day. They make the finest of beef and veal; when intended to be used for working oxen, they are easily broken and are fast walkers.

The cows are persistent milkers, with good teats; where used to produce grade animals they give the best of satisfaction, with the Swiss characteristics predominating. There are now about 1800 recorded animals in this country, located in almost every State, and some in Mexico.

YIELD OF MILK AND FAT FROM DAIRY COWS.

A good dairy cow should give at least 5000 pounds of milk during a whole period of lactation. As the quality of milk given by different cows varies greatly, however, as will be apparent from the tables given in the following, the yield of fat produced during a lactation period is a better standard to go by than that of the milk; three-fourths of a pound of fat per day for an average of 300 days may be considered a good yield (total 225 pounds). Many dairy farmers aim to have all mature cows in their herds produce a pound of fat, on the average, for every day in the year. To do this, a cow whose milk tests about 4 per cent. must give 25 pounds of milk a day (3 gallons) as an average for the whole year; a cow producing 3 per cent milk must give $33\frac{1}{3}$ pounds of milk daily, and one producing 5 per cent milk must yield 20 pounds of milk daily, on the average, etc.

The flow of milk is usually at its highest shortly after calving, and then gradually decreases, the rate of decrease being determined by the inbred milking qualities of the cow and the system of feeding practised. The average decrease in milk yield for good dairy cows on good feed is from one half to three fourths of a pound per head per ten days. Where cows are not fed liberally and receive but little concentrated feed, the decrease will be more marked, and often exceed one pound of milk per head per ten days. The decrease is more marked during the latter stages of the period of lactation than in the earlier ones, and is also more marked in cows with poorly developed milking qualities than in good dairy cows. A cow is considered at her best when from five to seven years old; the constitutional strength of the animal, the system of feeding practised, and the general treatment given the cow will determine her period of usefulness.

The quality of the milk produced by individual cows generally remains fairly uniform through the greater portion of the lactation period, and is not permanently influenced in any marked manner by feed or any external conditions. During the last couple of months, when the

yield of milk is decreasing more rapidly than before, the quality is generally improved to some extent, the variation being, as a rule. within 1 per cent. Variations of several per cents of fat may sometimes occur from day to day, or milking to milking, in the milk from single cows; variations amounting to 1 per cent are common. Herd milk varies much less, the percentages of fat on subsequent days being as a rule within two tenths of one per cent, and only exceptionally near one per cent.

RESULTS OF TESTS OF DAIRY BREEDS Conducted by American Agricultural Experiment Stations.

Breed.	No. of Cows Included.	No. of Lactation Periods.	Average Yields per Lactation Period.		Average per cent. Fat.	Average Cost of		
			Milk.	Fat.		Food Eaten per Day.	Producing 100 lbs. Milk.	Producing 1 lb. Fat.
			lbs.	lbs.		cents	cents	cents
New York (Geneva):								
Jersey	4	11	5045	282.1	5.60	12.4	90	16.1
Guernsey......	4	6	5385	285 5	5.30	12.5	86	16.1
Holstein	4	4	7918	266.1	3.36	13.9	65	19.1
Ayrshire.......	4	12	6824	244.8	3.60	13.5	74	20.2
Short Horn....	1	2	6055	269.0	4.44	12.7	78	17.2
Devon	3	5	3984	183.3	4.60	10.3	94	20.5
American Holderness.......	2	4	5721	213.1	3.73	12.2	76	20.1
Maine:								
Jersey.....	2	4	5460	297.0	5.50	16.2	113.0	20.4
Holstein.......	2	3	8369	285.0	3.47	19.5	83.1	24.3
Ayrshire.......	2	4	6612	233.0	3.67	17.1	94.9	26.8
New Jersey:								
Jersey....	3	3	7695	376.3	4.89	16.1	87.1	17.9
Guernsey......	4	4	7446	379.0	5.09	14.9	78.1	15.3
Holstein..	3	3	8455	300.2	3.55	19.3	79.3	22.4
Ayrshire.......	4	4	7461	275.3	3.69	15.0	76.0	20.6
Short Horn...	3	3	10457	396.3	3.79	15.4	79.2	20.6
Averages for all Breeds and Lactation Periods.								
Jersey	9	18	5579	301.1	5.40	13.9	94.7	17.4
Guernsey........	8	10	6210	322 9	5.20	13.5	82.8	15.8
Holstein.....	9	10	8215	282.0	3.43	17.2	74.7	21.5
Ayrshire.........	10	20	6909	248.5	3.60	14.5	78.5	21.5
Short Horn......	4	5	8696	345.4	3.97	14.3	78.7	19.4
Devon	3	5	3984	183.3	4.60	10.3	94.0	20.5
American Holderness	2	4	5721	213.1	3.73	11.2	76.0	20.1
Total....	45	72						

The animals included in the foregoing breed tests rank on the average as follows:

1. *As to yield of fat:* Shorthorn, Guernsey, Jersey, Holstein, Ayrshire, American Holderness, Devon.

2. *As to cost of producing* 1 *lb. of fat:* Guernsey, Jersey, Shorthorn, American, Holderness, Devon, Holstein and Ayrshire.

3. *As to yield of milk:* Shorthorn, Holstein, Ayrshire, Guernsey, American Holderness, Jersey, Devon.

4. *As to cost of producing* 100 *lbs. of milk:* Holstein, American Holderness, Ayrshire, Shorthorn, Guernsey, Devon, Jersey.

5. *As to cost of food:* Devon, American Holderness, Guernsey, Jersey, Shorthorn, Ayrshire, Holstein.

6. *As to richness of milk:* Jersey, Guernsey, Devon, Shorthorn, American Holderness, Ayrshire, Holstein.

RESULTS OF BREED TESTS CONDUCTED AT WORLD'S COLUMBIAN EXPOSITION, 1893.

A. **Breed Test No. 1** (Cheese Test), May 10 to 25.

	Milk Produced, lbs.	Fat Produced, lbs.	Cheese, lbs.	Price of Cheese per lb., cents.	Cost of Feed.	Net Gain.
25 Jerseys...... ...	13,296.4	601 91	1451.8	13.36	$98.14	$119.82
25 Guernseys	10,938.6	488.42	1130.6	11.95	76.25	88.30
25 Short-horns.....	12,186.9	436.60	1077.6	13.00	99.36	81.36

B. **Breed Test No. 2** (Ninety-day Butter Test), June 1 to Aug. 29.

			Butter credited	Price of Butter.		
25 Jerseys..........	73,488.8	3516.08	4274.01	$1747.37	$587.50	$1323.81
25 Guernseys	61,781.7	2784.56	3360.43	1355.44	484.14	997.64
24 Short-horns......	66,263.2	2409.97	2890.87	1171.77	501.79	910.12

AVERAGES PER DAY PER COW.

			Fat, per cent.	Cost of Food.
Jerseys	32.7	1.56	4.78	26.1 cts.
Guernseys.........	27.5	1.24	4.51	21.5 "
Short-horns..	30.7	1.12	3.64	23.2 "

C. **Breed Test No. 3** (Thirty-day Butter Test), Aug. 29 to Sept. 28.

			Butter credited	Price of Butter.		
15 Jerseys..........	13,921.9	685.81	837.21	$385.59	$111.24	$274.13
15 Guernseys	13,518.4	597.96	724.17	329.77	92.77	237.00
15 Short-horns.....	15,618.3	555.43	662.67	303.69	104.55	198.89

D. **Breed Test No. 4** (Heifer Test), Sept 30 to Oct. 20.

7 Jerseys...........	3356.6	155.38	194.23	$77.69	$34.44	$56.28
6 Short-horns......	2581.0	97.89	122.36	48.95	23.53	47.42

AVERAGE YIELDS OF MILK AND FAT BY PREMIUM COWS AT RECENT STATE FAIRS.

State.	Name of Cow.	Breed.	Milk.	Fat.	Fat.	Test made at
			lbs.	lbs.	p.c.	
New York.	Intze Von Hollingen......	Holstein	58.55	1.691	2.89	Fair grounds.
Maine.	... .	Jersey	48.68	2.190	4.50	" "
Mass.	Weston Lily..... .	Guernsey	43.50	2.150	4.94	Home.
Ohio.	Very Much........	Jersey	44.75	2.060	4.62	"
	Lady of Lyons 6th	Holstein	72.86	2.110	2.90	"
Indiana.	Nahe 2d....	"	47.00	1.553	3.30	Fair grounds.
Illinois.	*Cows over 3 yrs. old.*					
	Beulah Shawlan...	Jersey	37.43	1.585	4.33	" "
	Cows under 3 yrs. old.					
	Kitty King.... ...	"	29.60	1.485	5.02	" "
Wisconsin.	Johanna 5th......	Holstein	83.95	2.500	2.98	Home.
	Daisy	Jersey	40.15	2.420	5.95	"
Iowa.	Eurodna...........	"	40.12	1.597	4.07	Fair grounds.
Nebraska.	Geertje Lefing.....	Holstein	50.31	1.510	3.00	" "
California.	Lady Woods	Jersey	38.58	2.626	6.74	" "
	Typha.............	Holstein	49.73	1.544	3.10	" "
Canada.						
Toronto.	Eunice Clay	"	65.00	1.590	2.45	" "
Guelph.	Calamity Jane.....	"	69.18	2.090	3.16	" "
Gananoque	Carmen Sylva. ...	"	69.00	1.914	2.80	" "

HIGHEST RECORD FOR YIELD OF FAT

During Twenty-four Hours Made by any Cow in a Public Test at a Fair.

BRIENZ, Brown-Swiss, 11 years old, weighing 1395 lbs.

Average daily yield of milk.............. 81.7 lbs.
" " " " fat................ 3.11 "
" per cent of fat in day's milk.... 3.81 "

(American Dairy Show, Chicago, 1891; 3-day test.)

OFFICIAL MILK AND BUTTER RECORDS.

	365 Days.	7 Days.	24 Hours.
A. Milk Records.	lbs.	lbs.	lbs.
I. *Holstein-Friesian:*			
Pietertje 2d, 3273 H. H. B.	30,318½		
Rosa Bonheur 5th, 11227 H. F. H. B.		726¼	
Shadeland Boon 2d, 8892 H. H. B.			122½
II. *Guernsey:*			
Lily of Alexander, No. 1059	12,855½		
III. *Ayrshire:*			
Rena Myrtle, 9530	12,172		
B. Butter Records.			
I. *Holstein-Friesian:*			
Pauline Paul, 852 A. R., 2199 H. H. B. (1 lb. butter from 16.18 lbs. milk.)	$1,153\frac{63}{64}$		
Natsey, 646 A. R., 2265 H. H. B (1 lb. butter from 15.87 lbs. milk.)		$34\frac{9}{16}$	
Elgin Belle, 840 A. R., 4640 H. H. B (1 lb. butter from 17.46 and 17.78 lbs. milk.)			4⅝
II. *Jersey:*			
Signal's Lily Flagg, No. 31035	$1,047\frac{3}{64}$*		
Princess 2d, No. 8046		$46\frac{50}{64}$†	
III. *Guernsey:*			
Bretonne, No. 3660	753.6		
Gully 5th, No. 1590		$24\frac{2}{16}$	
Lucille, No. 115			$3\frac{3}{32}$
IV. *Ayrshire:*			
Rena Myrtle, 9530	546		
Duchess of Smithfield, 4256		$19\frac{6}{16}$	

* From 11,339 lbs. of milk. † From 299½ lbs. of milk.

RESULTS OF ENGLISH MILKING TRIALS.

(Averages of breed-tests conducted at the annual dairy shows of the British Dairy Farmers' Assoc., 1879–95, inclusive.)

Total No. of Animals.	Breed.	Average Yield of Milk per Day.	Total Solids. Yield per Day.	Total Solids. Per Cent.	Fat. Yield per Day.	Fat. Per Cent.	Solids not Fat, Per Cent.	Live Weight.
		lbs.	lbs.		lbs.			lbs.
174	Shorthorns	44.58	5.64	12.66	1.63	3.65	9.01	1406 (55)*
207	Jerseys	27.99	4.06	14 51	1.37	4.90	9.61	846 (92)
70	Guernseys	28.78	4.04	14.04	1.37	4.77	9.27	1037 (21)
10	Holsteins (Dutch)	45.19	5.53	12.25	1.54	3.41	8.84	1383 (3)
21	Ayrshires	37.73	5.34	13.52	1.68	4.25	9.27	1077 (10)
2	Devons	30.12	4.32	14.34	1.48	4.90	9.44	
19	Red Polls	38.84	4.91	12.64	1.49	3.84	8.80	1123 (16)
1	Welsh	46.00	5.86	12.74	1.91	4.16	8.58	
1	Aberdeen Angus.	60.30	8.29	13.74	3.01	4.99	8.75	
12	Kerries and Dexter Kerries.	26.59	3.56	13.37	1.11	4.18	9.19	749 (9)
39	Crosses	41.59	5.72	13.77	1.66	4.0	9.77	1250 (13)
556								

* Average for 55 animals.

ENGLISH STANDARDS FOR ANNUAL YIELD OF MILK OF THE VARIOUS BREEDS.

The standards proposed for the respective breeds by the British Dairy Farmers' Association for entry in the "Dairy Cattle Register" are as under:

Pedigree and Non-Pedigree.	Weight of Milk in the Milking Period (not exceeding 11 months). lbs.	Pure Butter Fat per Day (average of two tests as determined by analysis). lbs.
Short-horn	8500	1.25
Jersey	6000	1.25
Guernsey	6000	1.25
Ayrshire	7500	1.00
Red Polled	7000	1.00
Kerry and Dexter Kerry	4500	0.75
Dutch (Holstein)	8500	1.00

The standard for crosses of either of the above will be the mean of the standards for the pure breeds. No animal is admitted whose milk contains less than 12 per cent of solids at any test. (McConnell.)

AVERAGE YIELDS AND COMPOSITION OF MILK OF DIFFERENT BREEDS. (Hucho.)

Breed.	Live Wt., Lbs.	Annual Yield.		Average Per Cent.			Per 1000 lbs. Live Wt.	
		Milk, lbs.	Fat, lbs.	Solids.	Fat.	Solids not Fat.	Milk, lbs.	Fat, lbs.
Short-horn	1300	6800	260	12.9	3.8	9.1	5200	200
Brown Swiss	1300	7300	275	13.0	3.8	9.2	5600	210
Holstein	1100	7700	230	11 8	3.0	8.2	7000	210
Guernsey	1050	6600	330	14.7	5.0	9.7	6300	310
Ayshire	1000	6600	245	12.5	3.7	8.8	6600	245
Jersey	900	6600	300	14.7	5.0	9.7	6700	330
Angler	900	6600	240	12.0	3.4	8.6	7300	270
Kerry	550	5000	190	12.5	3.8	8.7	9000	350

AVERAGE PERCENTAGE COMPOSITION OF MILK FROM DIFFERENT BREEDS. (König.)

Name of Breed.	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Total Solids.	Solids not Fat.
Steyer (Austrian)	12	86.90	4.17	3.24	4.96	.73	13.10	8.93
Simmenthal (Swiss)	6	87 26	3.79	2.64	5.81	.70	12.74	8.95
Tillerthal (Tyrolean)	22	87.43	3.70	3.07	5.10	.70	12.57	8.87
Vorarlberg (Austrian)	19	87.38	3.54	2.91	5.40	.77	12.62	9.08
Algau (Bavarian)	4	87.88	3.20	3.22	5.13	.57	12.12	8.92
Bohemian	2	86.00	5.06	3.67	4.63	.64	14.00	8 94
Holstein	24	88.04	3.25	3.99	4.16	.56	11.96	8.71
Oldenburg (German)	18	87.95	3.38	3.10	4.81	.76	12.05	8.67
Angler (Danish)	10	88.15	3.12	....	....	...	11.85	8.73
Short-horn	67	87.20	3.47	3.21	5.43	.69	12.80	9.33
Devon	20	86.57	4.44	....	....	.64	13 43	8.99
Ayrshire	43	86.93	3.58	3.42	5.43	.64	13.07	9.49
Jersey	31	85.90	4.32	3.34	5.70	.74	14.10	9.78
Guernsey	26	85.39	5.11	3.98	4.38	1.14 (?)	14.61	9.50
French	12	87.20	3.90	3.07	5.06	.77	12.80	8.90
Scandinavian	4	88.00	3.51	2.76	4.97	.76	12.00	8.49

METHODS OF JUDGING THE VALUE OF DAIRY COWS.

The *British Dairy Farmers' Association*, which has conducted tests of dairy cows at their annual fair for the last fifteen years, has scored the dairy cows competing for premiums according to the following scale during late years:

1 point for each pound of milk;
20 points for each pound of fat;
4 points for each pound of solids not fat.
1 point for each ten days in milk after the first twenty days (limit 200 days).
10 points are deducted from the total score for each per cent. of fat below three per cent in the milk.

The cows entered in the test are separated into four classes, according to the breed, each class being divided into two divisions, cows and heifers. The classes are Shorthorns, Jerseys, Guernseys, and cross-breeds.

Other associations abroad or in this country have not generally followed any definite plan from year to year in awarding premiums to dairy cows at fairs, the awards having

been given to cows producing most milk, or richest milk, or most butter-fat, or most solids, during the test, which may have lasted one to three days. At the Vermont State Fair, 1889, the following points were given: For each 20 days since calving, 1 point; for each 10 days of gestation, 1 point; for each 2 oz. of total solids in 24 hours' milk, 1 point; for each oz. of butter-fat in 24 hours' milk, 2 points; for each 2 oz. of salted butter from 24 hours' milk, 1 point. In the milking trials conducted by the Royal Agricultural Society of England, the size of the cows has been considered, the cows being, as a rule, separated into two classes, viz., over and under 1100 lbs. live weight.

From the best information at hand at the present, the system of awards adopted by the British Dairy Farmers' Association, and given above, must be considered the most perfect and the most just to all concerned. Its main shortcomings lie, as it would seem, in its not considering the food eaten by each animal during the test, and in the fact that the test is made at the fair and not at home under every-day conditions and in surroundings familiar to the animals. The former objection would be removed by taking into account the dry matter in the food eaten, as shown by chemical analysis.

BUYING AND SELLING COWS BY TESTS OF THEIR MILK. (EMERY.)

The money value of a cow may be estimated by multiplying the number of gallons of milk which the cow gives by 12, adding to or subtracting from this product one dollar for every one fourth per cent of fat in the milk above or below 3.5 per cent.

$$\text{Value} = \frac{\text{pounds of milk per day}}{8\frac{2}{3}} \times 12 + 4\,(\text{per cent fat} - 3.5).$$

(See Bull. No. 113, N. C. Exp. Station.)

II. MILK.

PERCENTAGE COMPOSITION OF VARIOUS KINDS OF MILK. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Specific Gravity.
Human	107	87.41	3.78	2.29	6.21	.31	1.0270
Mare	50	90.78	1.21	1.99	5.67	.35	1.0347
Buffalo	8	82.25	7.51	5.05	4.44	.75	1.0330
Ass	7	89.64	1.64	2.22	5.99	.51	1.0345
Cow	793	87.17	3.69	3.55	4.88	.71	1.0316
Ewe	32	80.82	6.86	6.52	4.91	.89	1.0341
Goat	38	85.71	4.78	4.29	4.46	.76	1.0328
Reindeer*	2	67.20	17.10	11.39	2.82	1.49	1.0477
Sow	8	84.04	4.55	7.23	3.13	1.05	1.038
Bitch	28	75.44	9.57	11.17	3.09	.73	1.035
Elephant	3	79.30	9.10	2.51	8.59	.50	1.0313
Hippopotamus	1	90.43	4.51	....	4.40	.11	......
Camel	3	86.57	3.07	4.00	5.59	.77	1.042
Llama	3	86.55	3.15	3.90	5.60	.80	1.034

* Werenskiold

AVERAGE ANALYSES OF AMERICAN SAMPLES OF DAIRY PRODUCTS. (Goessmann.)

	Whole Milk.	Skim-milk.	Butter-milk.	Cream from Cooley Creamer.	Butter.
No. of samples	1889	348	31	197	25
Water	86.53	90.52	91.67	73.90	10.89
Fat	4.14	.32	.27	17.66	83.95
Casein and albumen	3.20	3.53	2.79	......	.42*
Milk-sugar	5.43*	4.83	4.47*	.....	......
Ash	.70	.80	.80	.62	4.74
	100.00	100.00	100.00	......	100.00
Total solids	13.47	9.48	8.33	26.10	89.11
Solids not fat	9.33	9.16	8.06	8.44	5.16

* By difference.

AVERAGE COMPOSITION OF COWS' MILK, WITH VARIATIONS. (König.)

	Average of 793 Analyses (largely European).	Minimum.	Maximum.
Water	87.17 per cent.	80.32 per cent.	90.69 per cent.
Fat	3.69 " "	1.67 " "	6.47 " "
Casein	3.02 } 3.55 per ct.	1.79 } 2.07 per ct.	6.29 } 6.40 per ct.
Albumen	.53	.25	1.44
Milk-sugar	4.88 per cent.	2.11 per cent.	6.12 per cent.
Ash	.71 " "	.35 " "	1.21 " "
	100.00		
Total solids	12.83 per cent.	9.31	19.68
Solids not fat	9.14 " "	....	....
Specific gravity	1.0316 " "	1.0264	1.0370

COMPOSITION OF MORNING AND EVENING MILK, AND OF MORNING, NOON, AND EVENING MILK. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk-sugar.	Ash.	Total Solids.
		Per ct.	Per ct	Per ct.	Per ct.	P'r ct.	Per ct.
Morning milk.	157	86.70	3.32	3.63	5.64	.71	13.30
Evening "	157	86.47	3.56	3.65	5.60	.72	13.53
Morning milk.	28	88.08	3.06	3.24	4.88	.74	11.92
Noon "	28	87.44	3.87	3.26	4.68	.75	12.56
Evening "	28	87.49	3.62	3.19	4.99	.71	12.51

COMPOSITION OF DIFFERENT PARTS OF THE SAME MILKINGS. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk-sugar.	Ash.	Total Solids.
		Per ct.	Per ct.	Per ct.	Per ct.	P'r ct.	Per ct.
First portion..	7	89.84	1.78	2.88	4.81	.69	10.16
Second " ..	7	88.12	3.34	2.94	4.92	.68	11.88
Third " ..	6	86.29	4.52	2.59	5.88	.72	13.71

CALCULATION OF COMPONENTS OF COWS' MILK.

According to Vieth the components of milk solids will stand in the ratio to one another of about

	10	:	13	:	2
for	casein and albumen	:	milk sugar	:	ash.

If the solids not fat in a sample of milk are 9 per cent, the per cent of casein and albumen in the same will be approximately $\frac{9}{25} \times 10 = 3.60$ per cent; sugar, $\frac{9}{25} \times 13 = 4.68$ per cent; and ash, $\frac{9}{25} \times 2 = .72$ per cent.

TABLE SHOWING RELATION OF FAT TO CASEIN AND OTHER SOLIDS. (COOKE.)

Total Solids.	Fat.	Casein and Albumen.	Milk-sugar and Ash.
11.00	3.07	2.92	5.01
11.50	3.29	3.00	5.21
12.00	3.50	3.07	5.43
12.50	3.75	3.19	5.56
13.00	3.99	3.30	5.71
13.50	4.34	3.44	5.72
14.00	4.68	3.57	5.75
14.50	4.93	3.79	5.68
15.00	5.38	4.00	5.62
15.50	5.69	4.15	5.66
16.00	6.00	4.30	5.70

This table, which is summarized from the analyses of about 2400 American samples of milk, shows that while the percentage of fat varies from 3.07 to 6 per cent, or nearly three per cent, that of casein varies only from 2.92 to 4.30 per cent, less than one and one half per cent. It also shows that a higher percentage of fat is always accompanied by a higher percentage of casein. Milk sugar and ash increase but little as the milk grows richer.

FERTILIZING INGREDIENTS IN DAIRY PRODUCTS.

Average of American Analyses. (Cooke and Hills.)

	Nitrogen.	Phosphoric Acid.	Potash.	Value per Ton.
Whole milk.....	.53%	.19%	.175%	$ 2.17
Skim-milk.......	.56	.20	.185	2.31
Cream...	.40	.15	.130	.66
Buttermilk......	.48	.17	.158	1.98
Whey..........	.15	.14	.181	.84
Butter..........	.12	.04	.036	.49
Cheese..........	3.93	.60	.120	14.19

COMPOSITION OF COLOSTRUM. (König.)

	No. of Analyses.	Water.	Casein.	Albumen.	Butter-fat.	Milk-sugar.	Ash.
Ewe.........	11	77.9	4.9	3.4	8.3	4.6	.9
Goat.........	1	64.1	5.2	3.2	24.5	....	3.0
Sow..........	1	70.1	7.6	8.0	9.5	3.9	.9
Cow..........	42	74.6	4.0	13.6	3.6	2.7	1.6

COMPOSITION OF ASH OF COWS' MILK AND COLOSTRUM.

	Cows' Milk.	Colostrum.
Total ash............	.7 per cent	1.6 per cent
100 parts of ash will contain :		
Potash........................	24 "	7 "
Soda	6 "	6 "
Lime..........................	23 "	35 "
Phosphoric acid.	28 "	41 "
Chlorin........	13 "	13 "

A CHAPTER ON MILK TESTING.

The Babcock milk test is the quick and simple method of determining the fat content of milk which has been most generally adopted in this country. The test was invented by Dr. S. M. Babcock, of Wisconsin Agricultural Experiment Station, and was first published in July, 1890. The following is an outline of the method:

A known quantity of milk (17.6 cubic centimeters, or about ⅔ of an ounce) is pipetted off into a graduated test-bottle; 17.5 cc. of commercial sulfuric acid, of a specific gravity of 1.82 to 1.83, is then measured out by means of a graduated cylinder or an automatic pipette, and added to the milk. The two fluids are mixed, and when the curd is dissolved, the test-bottles are placed in a centrifugal machine and whirled for 5 minutes at a rate of 800–1200 revolutions per minute, the small hand-machines on the market requiring the higher number of revolutions. Boiling hot water is then filled into the bottles, by which means the liquid fat is brought into the narrow graduated neck of the bottles; after an additional whirling of the bottles for a minute, the length of the column of fat is read off in per cent.

The whole process of testing a sample of milk according to this method will take less than a quarter of an hour when a little skill in manipulation has been reached.

The various dealers in dairy implements have placed Babcock machines on the market in sizes from 4- to 60-bottle machines, and supply the necessary outfit, as test-bottles, pipettes, graduates, and sulfuric acid. There are at present three different types of machines—hand-machines (friction or cog-wheel machines; the latter ones are to be preferred, but are also somewhat more expensive), steam turbine, and belt-power machines. In Sharples' Russian Babcock Tester (a steam turbine test) the bottles used can be filled while the machine is in motion; the results are, however, apt to come somewhat too low; the test bottles used

are arranged for half the usual quantity of milk. The "No-Tin" test manufactured by the same firm is one of the best hand-machines on the market. Steam turbine machines are to be recommended for factory use; they should always be provided with a speed indicator so as to avoid too slow or too rapid whirling; accidents have happened in several cases where the bottles were unable to stand the pressure caused by too rapid whirling.

Points to be watched in making tests by the Babcock method:

The strength of the acid used is very important; its specific gravity should not go below 1.82 or above 1.84; if the acid is somewhat too strong less may be taken, and a little more if it is rather weak. It is, however, not possible to make a satisfactory test with acid of a specific gravity below 1.82. Keep the acid bottle corked when not in use, as the acid will otherwise take up moisture from the air.

In testing separator skim-milk use a somewhat larger quantity of acid than usual, and whirl 5 to 6 minutes; this will insure a perfect separation of all the fat present in such milks. The two-necked so-called Ohlsson bottles are recommended for testing separator skim-milk.

The centrifugal machines should run at a rate of about 800 to 1000 revolutions per minute; if its diameter is small, whirl 1000 or 1200.

Soft or rain-water is used in filling up the bottle after boiling, or hard water may be used if some drops of sulfuric acid have been added to it before the boiling.

In adding the acid the bottle should be held at an angle, so as to cause the acid to follow the inside of the wall. Mix the milk and acid at once, or within a short time, and proceed with the test without delay.

Read off results before the fat begins to crystallize. If many tests are made at a time, and the room is cold, place the bottles in a pail with hot water and keep them warm until results are recorded.

Application of Babcock's Test.—The method may be used to advantage in determining the fat content of full milk, skim-milk, buttermilk, whey, cream, condensed milk, and cheese. It cannot be recommended for the estimation of fat in butter, since the error of analysis in this case is too large. In testing separator skim-milk, buttermilk, and whey by this method, no reading should be taken lower than one-tenth of one per cent. If only a small drop or two of liquid fat appears in the neck of the bottles after finished whirling, the result is therefore to be put down as .1 per cent, instead of estimates of .05, and still lower, which are sometimes made. (See Bull. No. 52, Wis. Experiment Station.)

Lactometer.—The Quevenne lactometer, with the thermometer tube extending into the narrow stem of the instrument, is recommended for dairy work. In the N. Y. Board of Health lactometer, often used, the scale is divided into 120 divisions, the mark 100 corresponding to a specific gravity of 1.029, and that of 120 to a specific gravity of 1.0348. These lactometer degrees can be converted into Quevenne lactometer degrees by multiplying by .29. The following table gives the readings of the two scales between 60 and 120 on the Board of Health lactometer:

TABLE SHOWING THE QUEVENNE LACTOMETER DEGREES CORRESPONDING TO THE SCALE OF LACTOMETERS GRADUATED FROM 0 TO 120.

N. Y. Bd. of Health Scale.	Quevenne Scale.	N. Y. Bd. of Health Scale.	Quevenne Scale.	N. Y. Bd. of Health Scale.	Quevenne Scale.
60	17.4	81	23.5	101	29.3
61	17.7	82	23.8	102	29.6
62	18	83	24.1	103	29.9
63	18.3	84	24.4	104	30.2
64	18.6	85	24.6	105	30.5
65	18.8	86	24.9	106	30.7
66	19.1	87	25.2	107	31
67	19.4	88	25.5	108	31.3
68	19.7	89	25.8	109	31.6
69	20	90	26.1	110	31.9
70	29.3	91	26.4	111	32.2
71	20.6	92	26.7	112	32.5
72	20.9	93	27	113	32.8
73	21.2	94	27.3	114	33.1
74	21.5	95	27.6	115	33.4
75	21.7	96	27.8	116	33.6
76	22	97	28.1	117	33.9
77	22.3	98	28.4	118	34.2
78	22.6	99	28.7	119	34.5
79	22.9	100	29	120	34.8
80	23.2				

In taking the specific gravity of milk by means of a lactometer, the temperature of the milk should not vary more than 10° either way from 60° F. The following tables show the proper corrections for temperature to be made, if the milk was either warmer or colder than 60° F., the temperature to which the specific gravities of all liquids are usually referred.

In practical work sufficiently accurate corrections for temperature may generally be made by adding .1 to the lactometer reading for each degree above 60° F., and by subtracting .1 for each degree below 60°; e.g., if the reading at 64° is 29.5, it will be about $29.5 + .4 = 29.9$ at 60°; if 34.0 at 52°, it will be about $34.0 - .8 = 33.2$ at 60°. By reference to the following table we find it is more correctly 33.0.

TEMPERATURE CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK. (Vieth.)

Reading.	Temperature of Milk (in Degrees Fahrenheit).															
Lactometer	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
20	19.0	19.0	19.1	19.1	19.2	19.2	19.3	19.4	19.4	19.5	19.6	19.7	19.8	19.9	19.9	20.0
21	19.9	20.0	20.0	20.1	20.2	20.2	20.3	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.9	21.0
22	20.9	21.0	21.0	21.1	21.2	21.2	21.3	21.3	21.4	21.5	21.6	21.7	21.8	21.9	21.9	22.0
23	21.9	22.0	22.0	22.1	22.2	22.2	22.3	22.3	22.4	22.5	22.6	22.7	22.8	22.8	22.9	23.0
24	22.9	22.9	23.0	23.1	23.2	23.2	23.3	23.3	23.4	23.5	23.6	23.6	23.7	23.8	23.9	24.0
25	23.8	23.9	24.0	24.0	24.1	24.1	24.2	24.3	24.4	24.5	24.6	24.6	24.7	24.8	24.9	25.0
26	24.8	24.9	24.9	25.0	25.1	25.1	25.2	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0
27	25.8	25.9	25.9	26.0	26.1	26.1	26.2	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0
28	26.7	26.8	26.8	26.9	27.0	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0
29	27.7	27.8	27.8	27.9	28.0	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0
30	28.6	28.7	28.7	28.8	28.9	29.0	29.1	29.1	29.2	29.3	29.4	29.6	29.7	29.8	29.9	30.0
31	29.5	29.6	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.8	30.9	31.0
32	30.4	30.5	30.5	30.6	30.7	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.9	32.0
33	31.3	31.4	31.4	31.5	31.6	31.8	31.9	32.0	32.1	32.3	32.4	32.5	32.6	32.7	32.9	33.0
34	32.2	32.3	32.3	32.4	32.5	32.7	32.9	33.0	33.1	33.2	33.3	33.5	33.6	33.7	33.9	34.0
35	33.0	33.1	33.2	33.4	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.0

TEMPERATURE CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK.—(*Continued.*)

Lactometer	Temperature of Milk (in Degrees Fahrenheit).														
Reading.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
20	20.1	20.2	20.2	20.3	20.4	20.5	20.6	20.7	20.9	21.0	21.1	21.2	21.3	21.5	21.6
21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	22.0	22.1	22.2	22.3	22.4	22.5	22.6
22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	23.0	23.1	23.2	23.3	23.4	23.5	23.7
23	23.1	23.2	23.3	23.4	23.5	23 6	23.7	23.8	24.0	24.1	24.2	24.3	24.4	24.6	24.7
24	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.9	25.0	25.1	25.2	25.3	25.5	25.6	25.7
25	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.9	26.0	26.1	26.2	26.4	26.6	26.6	26.8
26	26.1	26.2	26.3	26.5	26.6	26.7	26.8	27.0	27.1	27.2	27.3	27.4	27.6	27.7	27.8
27	27.1	27.3	27.4	27.5	27.6	27.7	27.8	28.0	28.1	28.2	28.3	28.4	28.6	28.7	28.9
28	28.1	28.3	28.4	28.5	28 6	28.7	28.8	29.0	29.1	29.2	29.4	29.5	29.7	29.8	29.9
29	29.1	29.3	29.4	29.5	29.6	29.7	29.9	30.1	30.2	30.3	30.4	30.5	30.7	30.9	31.0
30	30.1	30.3	30.4	30.5	30.7	30.8	30.9	31.1	31.2	31.3	31.5	31.6	31.8	31.9	32.1
31	31.2	31.3	31.4	31.5	31.7	31.8	31.9	32.1	32.2	32.4	32.5	32.6	32.8	33.0	33.1
32	32.2	32.3	32.5	32.6	32.7	32.9	33.0	33.2	33.3	33.4	33.6	33.7	33.9	34.0	34.2
33	33.2	33.3	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.1	35.2
34	34.2	34.3	34.5	34.6	34.8	34.9	35.0	35.2	35.3	35.5	35.6	35.8	36.0	36.1	36.3
35	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	36.5	36.7	36.8	37.0	37.2	37.3

Directions.—Bring the temperature of the milk to within 10° from 60° F. Take the reading of the lactometer and that of the temperature of the milk; find the former in the first vertical column of the table and the latter in the first horizontal row of figures; the figure where the horizontal and vertical columns meet is the corrected lactometer reading; e.g., observed, 31.0 at 67° F.; corrected reading, 31.9.

CALCULATION OF TOTAL SOLIDS OF MILK.

The relation existing between the various components of the milk is such as to make possible the calculation of the percentage of solids not fat, and total solids, in a sample of milk when the fat-content and the specific gravity (lactometer reading) of the milk are known. Several formulas have been worked out by chemists in different parts of the world, by the application of which the total solids may be calculated from the percentage of fat and the specific gravity of the milk. We give here Babcock's formula, published in the twelfth report of Wisconsin Experiment Station.

$$\text{Solids not fat} = \left(\frac{100s - sf}{100 - 1.0753sf} - 1\right) \times (100 - f)\, 2.5,$$

where s = specific gravity of the milk and f per cent of fat found. When s and f are known the per cent of solids not fat in the milk may be calculated by means of this formula. In order to avoid making the lengthy calculations in every case, tables for solids not fat are given on the following pages; results obtained by the formula given above, or by means of the following tables, will come within a couple of tenths from the actual percentages present, when reasonable care is taken in the determinations of fat and specific gravity (or lactometer reading).

Short formulas. The following formulas for solids not fat and for total solids are derived from the data given in the following tables. L = lactometer reading at 60° F. (specific gravity $\times$ 1000 − 1000); f = per cent of fat in milk.

$$\text{Solids not fat} = \frac{L}{4} + .2f$$

$$\text{Total solids} = \frac{L}{4} + 1.2f.$$

Rule: To find per cent of solids not fat, add two tenths of the per cent of fat to one fourth of the lactometer reading.

To find per cent of total solids, add one and two tenths times the per cent of fat to one fourth of the lactometer reading.

Results obtained by using the short formulas will agree very closely with those derived from the general formula, or from the tables published below, and may be safely relied upon in practical work.

The tables cover a range of .0 to 6.0 per cent of fat, and from 26 to 36 lactometer reading. If intermediate values for f and L are at hand, corrections in the per cent of solids not fat found may easily be made, with .02 per cent for every tenth of one per cent of fat, and .25 per cent for every lactometer degree. *Example:* Given $f =$ 3.67 per cent and $L = 32.5$. By referring to the table we find that $f = 3.6$ and $L = 32$ will give 8.73 per cent of solids not fat; correction for fat-content, .01 per cent (3.67 being nearer 3.65 than 3.70), and for lactometer reading, 12 per cent; corrected per cent solids not fat, 8.86.

TABLE SHOWING PER CENT OF SOLIDS NOT FAT, Corresponding to Quevenne Lactometer Readings and Per Cent of Fat. (BABCOCK.)

Per Ct. of Fat.	Lactometer Readings at 60° Fahr.											Per Ct. of Fat.
	26	27	28	29	30	31	32	33	34	35	36	
.0	6.50	6.75	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.75	9.00	.0
.1	6.52	6.77	7.02	7.27	7.52	7.77	8.02	8.27	8.52	8.77	9.02	.1
.2	6.54	6.79	7.04	7.29	7.54	7.79	8.04	8.29	8.54	8.79	9.04	.2
.3	6.56	6.81	7.06	7.31	7.56	7.81	8.06	8.31	8.56	8.81	9.06	.3
.4	6.58	6.83	7.08	7.33	7.58	7.83	8.08	8.33	8.58	8.83	9.08	.4
.5	6.60	6.85	7.10	7.35	7.60	7.85	8.10	8.35	8.60	8.85	9.10	.5
.6	6.62	6.87	7.12	7.37	7.62	7.87	8.12	8.37	8.62	8.87	9.12	.6
.7	6.64	6.89	7.14	7.39	7.64	7.89	8.14	8.39	8.64	8.89	9.14	.7
.8	6.66	6.91	7.16	7.41	7.66	7.91	8.16	8.41	8.66	8.91	9.16	.8
.9	6.68	6.93	7.18	7.43	7.68	7.93	8.18	8.43	8.68	8.93	9.18	.9
1.0	6.70	6.95	7.20	7.45	7.70	7.95	8.20	8.45	8.70	8.95	9.20	1.0
1.1	6.72	6.97	7.22	7.47	7.72	7.97	8.22	8.47	8.72	8.97	9.22	1.1
1.2	6.74	6.99	7.24	7.49	7.74	7.99	8.24	8.49	8.74	8.99	9.24	1.2
1.3	6.76	7.01	7.26	7.51	7.76	8.01	8.26	8.51	8.76	9.01	9.26	1.3
1.4	6.78	7.03	7.28	7.53	7.78	8.03	8.28	8.53	8.78	9.03	9.28	1.4
1.5	6.80	7.05	7.30	7.55	7.80	8.05	8.30	8.55	8.80	9.05	9.30	1.5
1.6	6.82	7.07	7.32	7.57	7.82	8.07	8.32	8.57	8.82	9.07	9.32	1.6
1.7	6.84	7.09	7.34	7.59	7.84	8.09	8.34	8.59	8.84	9.09	9.34	1.7
1.8	6.86	7.11	7.36	7.61	7.86	8.11	8.36	8.61	8.86	9.11	9.37	1.8
1.9	6.88	7.13	7.38	7.63	7.88	8.13	8.38	8.63	8.88	9.14	9.39	1.9
2.0	6.90	7.15	7.40	7.65	7.90	8.15	8.40	8.66	8.91	9.16	9.41	2.0
2.1	6.92	7.17	7.42	7.67	7.92	8.17	8.42	8.68	8.93	9.18	9.43	2.1
2.2	6.94	7.19	7.44	7.69	7.94	8.19	8.44	8.70	8.95	9.20	9.45	2.2
2.3	6.96	7.21	7.46	7.71	7.96	8.21	8.46	8.72	8.97	9.22	9.47	2.3
2.4	6.98	7.23	7.48	7.73	7.98	8.23	8.48	8.74	8.99	9.24	9.49	2.4
2.5	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.76	9.01	9.26	9.51	2.5
2.6	7.02	7.27	7.52	7.77	8.02	8.27	8.52	8.78	9.03	9.28	9.53	2.6
2.7	7.04	7.29	7.54	7.79	8.04	8.29	8.54	8.80	9.05	9.30	9.55	2.7
2.8	7.06	7.31	7.56	7.81	8.06	8.31	8.57	8.82	9.07	9.32	9.57	2.8
2.9	7.08	7.33	7.58	7.83	8.08	8.33	8.59	8.84	9.09	9.34	9.59	2.9
3.0	7.10	7.35	7.60	7.85	8.10	8.36	8.61	8.86	9.11	9.36	9.61	3.0
3.1	7.12	7.37	7.62	7.87	8.13	8.38	8.63	8.88	9.13	9.38	9.64	3.1
3.2	7.14	7.39	7.64	7.89	8.15	8.40	8.65	8.90	9.15	9.41	9.66	3.2
3.3	7.16	7.41	7.66	7.92	8.17	8.42	8.67	8.92	9.18	9.43	9.68	3.3
3.4	7.18	7.43	7.69	7.94	8.19	8.44	8.69	8.94	9.20	9.45	9.70	3.4
3.5	7.20	7.45	7.71	7.96	8.21	8.46	8.71	8.96	9.22	9.47	9.72	3.5
3.6	7.22	7.48	7.73	7.98	8.23	8.48	8.73	8.98	9.24	9.49	9.74	3.6
3.7	7.24	7.50	7.75	8.00	8.25	8.50	8.75	9.00	9.26	9.51	9.76	3.7
3.8	7.26	7.52	7.77	8.02	8.27	8.52	8.77	9.02	9.28	9.53	9.78	3.8
3.9	7.28	7.54	7.79	8.04	8.29	8.54	8.79	9.04	9.30	9.55	9.80	3.9
4.0	7.30	7.56	7.81	8.06	8.31	8.56	8.81	9.06	9.32	9.57	9.83	4.0
4.1	7.32	7.58	7.83	8.08	8.33	8.58	8.83	9.09	9.34	9.59	9.85	4.1
4.2	7.34	7.60	7.85	8.10	8.35	8.60	8.85	9.11	9.36	9.62	9.87	4.2
4.3	7.36	7.62	7.87	8.12	8.37	8.62	8.88	9.13	9.38	9.64	9.89	4.3
4.4	7.38	7.64	7.89	8.14	8.39	8.64	8.90	9.15	9.40	9.66	9.91	4.4

TABLE FOR SOLIDS NOT FAT—(*Continued*).

Per Ct. of Fat.	Lactometer Readings at 60° Fahr.											Per Ct. of Fat.
	26	27	28	29	30	31	32	33	34	35	36	
4.5	7.40	7.66	7.91	8.16	8.41	8.66	8.92	9.17	9.42	9.68	9.93	4.5
4.6	7.43	7.68	7.93	8.18	8.43	8.68	8.94	9.19	9.44	9.70	9.95	4.6
4.7	7.45	7.70	7.95	8.20	8.45	8.70	8.96	9.21	9.46	9.72	9.97	4.7
4.8	7.47	7.72	7.97	8.22	8.47	8.72	8.98	9.23	9.48	9.74	9.99	4.8
4.9	7.49	7.74	7.99	8.24	8.49	8.74	9.00	9.25	9.50	9.76	10.01	4.9
5.0	7.51	7.76	8.01	8.26	8.51	8.76	9.02	9.27	9.52	9.78	10.03	5.0
5.1	7.53	7.78	8.03	8.28	8.53	8.79	9.05	9.29	9.54	9.80	10.05	5.1
5.2	7.55	7.80	8.05	8.30	8.55	8.81	9.06	9.31	9.56	9.82	10.07	5.2
5.3	7.57	7.82	8.07	8.32	8.57	8.83	9.08	9.33	9.58	9.84	10.09	5.3
5.4	7.59	7.84	8.09	8.34	8.60	8.85	9.10	9.36	9.61	9.86	10.11	5.4
5.5	7.61	7.86	8.11	8.36	8.62	8.87	9.12	9.38	9.63	9.88	10.13	5.5
5.6	7.63	7.88	8.13	8.39	8.64	8.89	9.15	9.40	9.65	9.90	10.15	5.6
5.7	7.65	7.90	8.15	8.41	8.66	8.91	9.17	9.42	9.67	9.92	10.17	5.7
5.8	7.67	7.92	8.17	8.43	8.68	8.94	9.19	9.44	9.69	9.94	10.19	5.8
5.9	7.69	7.94	8.20	8.45	8.70	8.96	9.21	9.46	9.71	9.96	10.22	5.9
6.0	7.71	7.96	8.22	8.47	8.72	8.98	9.23	9.48	9.73	9.98	10.24	6.0

MILK STANDARDS IN DIFFERENT STATES, CITIES, AND COUNTRIES.

	Solids.	Fat.	Solids Not Fat.	Law or Ordinance of
	per ct.	per ct.	per ct.	
Maine	12.0	3.0	[9.0]	1893,255
New Hampshire	13.0	... ...	....	1883
Vermont	12.5	[3.25]	9.25	1888,108
in May and June	12.0	3.0	[9.0]	
Massachusetts	13.0	[3.7]	9.3	1886,318
in May and June	12.0	....	....	
skimmed milk	....	....	9.3	1885,252
New York	12.0	3.0	[9.0]	1893,338
New Jersey	12.0	....	....	1882,82
Pennsylvania*	12.5	3.0	[9.5]	1885,106
Ohio	12.5	3.0	[9.5]	1889,86
Michigan*	12.5	3.0	[9.5]	1889,219
Wisconsin	....	3.0	. ...	1889,425
Minnesota†	13.0	3.5	[9.5]	1889,247
Iowa	....	3.0	....	1892,50
Oregon‡	12.5	3.2	[9.3]	1893
City of Chicago	12.0	3.0	[9.0]	1892
" " St. Louis	12.0	2.8	[9.2]	
" " " " cream	22.0	12.0	[10.0]	1887
" " Omaha	12.0	3.0	[9.0]	
" " " cream	....	16.0	....	1893
" " Denver	12.0	....	....	1893
England	[11.5]	2.5	9.0	....
Switzerland	12.0	3.0	[9.0]	1895

* Specific gravity, 1.029-1.033 at 60° F. † Cheese, 40 per cent fat in solids. ‡ Butter, 14 per cent water.

ADULTERATION OF MILK.

The legal standards adopted in the different States of the Union determine the limits for fat or solids, below which the milk offered for sale must not fall. Where no control sample can be taken of a suspected sample of milk, calculations of the extent of the adulteration practised are made on basis of the legal standard in each State. Whenever possible, a control sample should be secured on the premises of the suspected party, and subjected to analysis. If the control sample contains appreciably less fat or solids not fat than did the suspected sample, the latter was skimmed or watered, or both skimmed and watered.

SKIMMING.—I. If a sample is skimmed, the following formula will give the number of pounds of fat abstracted from 100 lbs. of milk:

$$\text{Fat abstracted} = x = \text{legal standard for fat} - f, \quad \text{(I)}$$

f being the per cent of fat in the suspected sample.

In this and following formulas the percentages found in the control samples, if such are at hand, are always to be substituted for the legal standards.

II. The following formula will give the per cent of fat abstracted, calculated on the total quantity of fat originally found in the milk:

$$x = 100 - \frac{f \times 100}{\text{leg. stand. for fat}} \quad \text{(II)}$$

WATERING.—I. If a sample is watered, the calculations are most conveniently based on the percentage of solids not fat in the milk:

Per cent extraneous water in milk

$$= x = 100 - \frac{s \times 100}{\text{leg. stand. for solids not fat}}, \quad \text{(III)}$$

s being the per cent of solids not fat in the suspected sample.

Example.—A sample contains 8.5 per cent of solids not fat; if the legal standard for solids not fat be 9 per cent, $100 - \frac{8.5 \times 100}{9} = 5.6$, will give the per cent of extraneous water in the suspected sample of milk.

II. Watering of milk may also be expressed in per cent of water added to the original milk, by formula IV:

Per cent water added to original milk

$$= x = \frac{100 \times \text{leg. stand. for solids not fat}}{s} - 100. \qquad \text{(IV)}$$

In the example given above, $\frac{100 \times 9}{8.5} - 100 = 5.9$ per cent of water was added to the original milk.

WATERING AND SKIMMING.—If a sample has been both watered and skimmed, the extent of watering is ascertained by means of formula III; and the fat abstracted found according to the following formula:

Per cent fat abstracted

$$= x = \text{leg. stand. for fat} - \frac{\text{leg. stand. for solids not fat}}{s} \times f. \qquad \text{(V)}$$

Example.—A sample of milk contains 2.4 per cent of fat and 8.1 per cent solids not fat; then

extraneous water in milk $= 100 - \frac{8.1 \times 100}{9} = 10$ per cent;

fat abstracted $= 3 - \frac{9 \times 2.4}{8.1} = .33$ per cent.

100 lbs. of the milk contained 10 lbs. of extraneous water and .33 lb. of fat had been skimmed from it.

TABLE FOR CONVERTING QUARTS OF MILK INTO POUNDS.

Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.
1	2.15	29	62.3	57	122.4	85	182.5
2	4.3	30	64.4	58	124.5	86	184.6
3	6.4	31	66.5	59	126.6	87	186.8
4	8.6	32	68.7	60	128.8	88	188 9
5	10.7	33	70.8	61	130.9	89	191 0
6	12.9	34	73.0	62	133.1	90	193.2
7	15.0	35	75.1	63	135.2	91	195.3
8	17.2	36	77.3	64	137.4	92	197.5
9	19.3	37	79.4	65	139.5	93	199.6
10	21.5	38	81.6	66	141.7	94	201 8
11	23.6	39	83.7	67	143.8	95	203.9
12	25.8	40	85.9	68	146.0	96	206.1
13	27.9	41	88.0	69	148.1	97	208.2
14	30.1	42	90.2	70	150.3	98	210.4
15	32.2	43	92.3	71	152.4	99	212.5
16	34.3	44	94.5	72	154.6	100	214.7
17	36.5	45	96.6	73	156.7	200	429.3
18	38.6	46	98.7	74	158.8	300	644.0
19	40.8	47	100.9	75	161.0	400	858 6
20	42.9	48	103.0	76	163.1	500	1073.3
21	45.1	49	105.2	77	165.3	600	1288 0
22	47.2	50	107.3	78	167.4	700	1502.6
23	49.4	51	109.5	79	169.6	800	1717.3
24	51.5	52	111.6	80	171.7	900	1931 9
25	53.7	53	113.8	81	173.9	1000	2146.6
26	55.8	54	115.9	82	176.0		
27	58.0	55	118.1	83	178.2		
28	60.1	56	120.2	84	180.3		

TABLE FOR CONVERTING POUNDS OF MILK INTO QUARTS.

Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts
1	.47	29	13.5	57	26.6	85	39.6
2	.93	30	14.0	58	27.0	86	40.1
3	1.40	31	14.4	59	27.5	87	40.5
4	1.86	32	14.9	60	28.0	88	41.0
5	2.33	33	15.4	61	28.4	89	41.5
6	2 80	34	15.8	62	28.9	90	41.9
7	3.26	35	16.3	63	29.4	91	42.4
8	3 73	36	16.8	64	29.8	92	42.9
9	4.19	37	17.2	65	30.3	93	43.3
10	4 66	38	17.7	66	30.8	94	43.8
11	5.13	39	18.2	67	31.2	95	44.3
12	5 59	40	18.6	68	31.7	96	44.7
13	6 06	41	19.1	69	32.2	97	45.2
14	6.52	42	19.6	70	32.6	98	45.7
15	6.99	43	20.0	71	33.1	99	46.1
16	7.46	44	20.5	72	33.6	100	46.6
17	7.92	45	21.0	73	34.0	200	93.2
18	8.39	46	21.4	74	34.5	300	139.8
19	8 85	47	21.9	75	35.0	400	186.4
20	9.32	48	22 4	76	35.4	500	233.0
21	9.79	49	22.8	77	35.9	600	279.6
22	10.3	50	23.3	78	36.3	700	326.2
23	10.7	51	23.8	79	36.8	800	372.8
24	11.2	52	24.2	80	37.3	900	419.4
25	11 7	53	24.7	81	37.7	1000	466.0
26	12.1	54	25.2	82	38.2		
27	12.6	55	25.6	83	38.7		
28	13.1	56	26.1	84	39.1		

III. CREAM.

PERCENTAGE COMPOSITION OF CREAM. (König.)

	Mean of 43 Analyses.	Minimum.	Maximum.
Water	68.82	22.83	83.23
Fat	22.66	15.19	29.93
Casein, Albumen, etc.	3.76	.63	7.88
Milk Sugar	4.23	.59	5.52
Ash	.53	.11	2.50
	100.00		

PERCENTAGE COMPOSITION OF DAIRY PRODUCTS. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Specific Gravity.	
Skim-milk, gravity creaming	56	90.43	.87	3.26	4.74	.70	1.0357	
Centrifugal skim-milk	7	90.60	.31	3.06	5.29	.74	1.0350	
Buttermilk	57	90.12	1.09	4.03	4.04	.72	1.0348	
Whey	46	93.38	.32	.86	4.79	.65	1.0272	
Preserved milk	4	87.97	3.21	3.34	4.74	.74	1.0313	
Condensed milk, (no sugar added)	36	58.99	12.42	11.92	14.49	2.18		
Condensed milk, (sugar added)	64	25.61	10.35	11.79	50.06*	2.19		
Scherff's condensed milk	5	72.87	6.62	8.20	10.63	1.68	Lactic acid.	Alcohol.
Koumiss (from mares' milk)	43	90.44	1.46	2.24	1.77	.42	.91	1.91
Koumiss (from cows' milk)	11	89.20	1.83	2.66	4.09	.43	.55	1.14
Kephir	22	91.21	1.44	3.49	2.41	.68	1.02	.75

* 13.84 per cent milk-sugar, 36.22 per cent cane-sugar.

YIELD OF CREAM FROM MILK OF DIFFERENT RICHNESS. (VIETH.)

Per cent Fat in Milk.	Per cent of Fat in Cream.																							
	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
	Number of Pounds of Cream from 1000 lbs. of Milk.																							
3.0	197	172	152	137	125	114	105	98	91	85	80	76	72	68	65	62	59	57	54	52	50	48	47	45
3.1	204	178	158	142	129	118	109	101	94	88	83	78	74	71	67	64	61	59	56	54	52	50	48	47
3.2	211	185	164	147	134	123	113	105	98	92	86	81	77	73	70	66	63	61	58	56	54	52	50	49
3.3	219	191	169	152	138	127	117	108	101	95	89	84	79	76	72	69	66	63	60	58	56	54	52	50
3.4	226	198	175	158	143	131	121	112	104	98	92	87	82	78	74	71	68	65	62	60	58	56	54	52
3.5	234	204	181	163	147	135	125	116	108	101	95	90	85	81	77	73	70	67	64	62	60	58	56	54
3.6	241	210	187	168	152	139	128	219	111	104	98	93	88	83	79	75	72	69	66	64	61	59	57	55
3.7	248	217	192	173	157	143	132	123	114	107	101	95	90	86	81	78	74	71	68	66	63	61	59	57
3.8	256	223	198	178	161	148	136	126	118	110	104	98	93	88	84	80	77	73	70	68	65	63	61	59
3.9	263	229	203	183	166	152	140	130	121	113	107	101	96	90	86	82	79	75	72	70	67	65	62	60
4.0	270	236	209	188	170	156	144	134	125	117	110	104	98	93	89	85	81	78	74	72	69	66	64	62
4.1	276	242	215	193	175	160	148	137	128	220	113	106	101	96	91	87	83	80	76	73	71	68	66	64
4.2	284	248	221	198	180	165	152	141	131	123	116	109	103	98	94	89	85	82	78	75	73	70	68	65
4.3	292	255	226	203	184	169	155	144	135	126	119	112	106	101	96	92	88	84	80	77	74	72	69	67
4.4	299	261	232	208	189	173	159	148	138	129	122	115	108	103	98	94	90	86	82	79	76	74	71	69
4.5	306	267	237	213	194	178	163	151	141	133	125	118	111	106	101	96	92	88	85	81	78	75	73	70
4.6	314	274	243	219	198	181	167	155	145	136	128	121	114	108	103	98	94	90	87	83	80	78	74	72
4.7	321	280	249	224	203	186	171	159	148	139	131	123	117	111	105	101	96	92	89	85	82	79	76	74
4.8	329	287	254	229	207	190	175	163	151	142	134	126	119	113	108	103	98	93	91	87	84	81	78	75
4.9	336	293	260	234	212	194	179	166	155	145	136	129	122	116	110	105	101	97	93	89	86	83	80	77
5.0	343	299	266	239	217	198	183	170	158	148	139	132	124	119	113	108	103	99	95	90	90	84	81	79

LIST OF HAND AND POWER CREAM SEPARATORS ON THE MARKET, 1896.

Name.	Capacity per Hour.	Retail Price.	Manufacturer or Agency.
A. HAND OR DAIRY SEPARATORS.	lbs.		
1. *De Laval "Baby" Cream Separators.*			
"Humming Bird"	175	$65	The De Laval Separator Co., N. Y. City.
Baby No. 1 ("hollow" bowl)	150	65	
" No. 1 ("disc" bowl)	250	90	
" No. 2	350	125	
" No. 3	675	200	
Dairy Turbine	700	225	
2. *U. S. Cream Separators*			
No. 3. Improved U. S. Sep.	650–700	200	Vermont Farm Machine Co., Bellows Falls, Vt.
No. 5. " " "	350–400	125	
No. 6. " " "	250–300	100	
No. 7. " (Midget)	200–220	75	
3. *Butter Accumulator.*			
No. 2 B as separator	600	200	Swedish Cream and Butter Separator Co., N. Y. City.
as accumulator	400		
4. *Keystone Cream Separator.*	400–500	100	Keystone Separator Co., Ltd., Philadelphia, Pa.
5. *Russian Steam Separators.*			
Little Giant Russian No. 1.	300	125	P. M. Sharples, West Chester, Pa.
" " " No. 2.	600	200	
Sharples Belt Separators.			
Safety Hand No. 1	300	125	
" " No. 2	600	200	
6. *Victoria Separators* (three styles)	100–300	80–125	Dairymen's Supply Co., Philadelphia, Pa.
The Empress Separator	750	225	
7. *Empire Separators.*			
The Mikado	225	75	D. H. Burrell & Co., Little Falls, N. Y.
The Empire "5"	450	125	
8. *The Eclipse Cream Separator* No. 0–5 (6 styles)	80–550	30–150	The C. L. Chapman Separator W'ks, Little Falls, N. Y.
9. *The Kneeland Omega Hand Separator.* No. 1 Jr.—No. 4 Jr. (5 styles)	200–600	75–150	Kneeland Crystal Creamery Co., Lansing, Mich.
10. *American Cream Separator*			
No. 2	350	100	Am. Separator Co., Bainbridge, N. Y.
No. 3	600	150	
B. POWER SEPARATORS.			
1. *Alpha Separators.*			
Alpha No. 1. Belt Power	2500	500	The De Laval Separator Co., N. Y. City.
" No. 2. " "	4000	750	
" No. 1. Steam Turbine	2500	525	
" No. 2. " "	4000	800	
Alpha Acme Belt Power	1300	350	
" " Steam Turbine	1300	375	
Standard Belt Power	1200	250	
" Turbine	1200	275	

HAND AND POWER CREAM SEPARATORS—(*Con.*).

Name.	Capacity per Hour.	Retail Price.	Manufacturer or Agency.
POWER SEPARATORS—(*Cont'd*).	lbs.		
2. *Russian Steam Separators.*			
The Standard Russian.....	1200–1500	$350	P. M. Sharples, West Chester, Pa.
The Imperial "	2000–2500	500	
Standard Belt Separators.			
The Standard Belt	1200–1500	350	
The Imperial "	2000–2500	500	
3. *U. S. Cream Separators.*			
The Improved No. 1 U. S. Separator..	2000–2500	400	Vermont Farm Machine Co., Bellows Falls, Vt.
The Improved No. 3 U. S. Separator...............	650–700	200	
No. 3 U. S. Cream Separator (low frame)...	600–700	200	
4. *Reid Improved Danish Separator*....................	2000–3000	500	A. H. Reid, Philadelphia, Pa.
5. *Columbia Cream Separators* (three styles)	300-600	100–150	Columbia Cream Separator Co., Avon, N. Y.
6. *Empire Power Separators.*			
Empire 10....	1000-1100	275	D. H. Burrell & Co., Little Falls, N.Y.
Empire 25.	2500	450	
7. *Butter Accumulator.*			
No. 1 A as separator.......	2000	400	Swedish Cream and Butter Separator Co., N. Y. City.
as accumulator.....	1200		
No. 2 A, B, & C as separator	600	200	
as accumulator...... ..	400		
	Butter		
No. 4 A, for cream only ...	35–40	400	
No. 4 B, " " "	20–25	200	
8. *Keystone Cream Separators.*			
No. 1.................... ..	900	225	Keystone Separator Co., Ltd., Philadelphia, Pa.
No. 2.......	1500	275	
No. 3.	2000	325	
9. *Victoria Power Separator.*			
Empress Power....	1000	325	Dairymen's Supply Co., Philadelphia, Pa.
	3500	500	
10. *The Eclipse Separator.*			
No. 6–9 (four styles)........	800-3000	225-600	The L. S. Chapman Separator Works, Little Falls, N.Y.

FORMULAS FOR FINDING THE FAT CONTENT OF CREAM.

Fleischmann's formula:

$$\text{Per cent fat in cream} = f_2 = \frac{100(f - f_1)}{R} + f_1,$$

where R = per cen. of cream obtained, f = per cent fat in milk, f_1 = per cent fat in skim-milk; or

$$f_2 = \frac{100F}{AR} \cdot B,$$

where F = per cent of fat in butter, B = yield of butter from 100 lbs. of milk, A = percentage churning. Under ordinary conditions of creaming these formulas may be simplified to

$$f_2 = 6.67f - 1.42,$$
$$f_2 = 5.77B.$$

Formula for finding the per cent cream to be separated when a certain fat content in the cream is wanted (Fleischmann):

$$x = \frac{100(f - f_1)}{f_2 - f_1};$$

f, f_1, and f_2 = per cent of fat in full milk, skim-milk, and cream, respectively.

HANDLING AND CARE OF CREAM SEPARATORS.

By J. D. Frederiksen, Little Falls, N. Y., Manager Chr. Hansen's Laboratory.

In selecting a separator, local conditions, space at disposal, nearness to its manufacturer who can put it up, be held responsible, and quickly attend to repairs, etc., may be of importance, and the following points should be considered:

Thorough Separation. — All manufacturers claim that their machines do perfect work, but they do not always come up to the claims. Under normal conditions *the measure for thoroughness of separation is the contents of butter-fat in the skim-milk as ascertained by the Babcock test.* The best modern separators skim practically absolutely clean, and there is now no excuse for anything but perfect skimming. With normal milk at the proper temperature run into the machine at the rate of the capacity claimed for it, *no separator should leave more than* 0.1% *of butter-fat in the skim-milk*, which is the smallest percentage that can be ascertained by the Babcock test with accuracy.

The table below gives the grand averages for the percentages of fat found in the trials of a number of the leading separators, conducted at the experiment stations of Delaware, Cornell (N. Y.), Vermont, Pennsylvania, and Wisconsin.

PER CENT FAT IN CENTRIFUGAL SKIM-MILK.

Style of Separator.	Averages of Trials at American Experiment Stations.	
	Number of Trials.	Per cent Fat in Skim-milk.
Butter Accumulator	11	.14
Columbia Cream Separator	19	.12
Reid's Impr. Danish Separator	8	.14
Danish-Weston "	3	.10
De Laval Alpha No. 1 "	2	.10
" Alpha Acme "	21	.09
" Alpha Turbine "	51	.09
" Alpha Baby No. 2 Separator	112	.08
" Alpha Baby No. 3 "	7	.125
" Horizontal Separator	9	.19
Jumbo Separator	4	.21
Sharples Russian Separator	34	.24
" Imperial "	30	.34
U. S. Butter Extractor Sep. No. 1	5	.24
Do. (as separator)	2	.14
U. S. Butter Extr. Sep. No. 2	8	.34
Do. No. 3	10	.21
U. S. Separator No. 1	9	.17
Do. No. 3	21	.10
Do. No. 5	27	.13
Victoria, 30 gal. Separator	25	.22
Do. 70 gal. "	12	.10

With the constant improvement in machines it is not difficult to find separators which will do perfect work.

Simplicity, durability and *safety of construction* are considerations of vital importance. The separator must be *simple* in construction so as to be easy to handle, to clean, and to oil. It must be *durable*, so that it will need but few repairs, and, first of all, it must be absolutely *safe*. Too many deplorable fatal accidents are already due to bursting separator bowls, and too much stress cannot be laid on the demand that the machine must by strongly built, of first-class material and workmanship, so that accidents are made impossible with reasonably careful handling.

As the pressure on the circumference of the bowl increases with the square of the speed, it is evident that the modern high-speed separators are exposed to a tremendous strain—in fact the tensile strain in some of them is as high as 20,000 to 30,000 lbs. to the square inch. Fortunately, the improvements in bearings and other features of construction

which have enabled manufacturers to increase the speed, have caused them at the same time to reduce the diameter of the bowl, which makes the modern machine much safer than the first crude and heavy separators.

Power.—Considering its capacity, a well-built separator requires comparatively little power, whether coal or muscle. But as either is money, it is a matter of importance that none be wasted. Many so-called hand separators are altogether too heavy to run by hand, hence in selecting one see that it is easy to keep it running for several hours. The tests made at the experiment stations by dynamometer, as well as by measuring the steam consumed, show that there is a great deal of steam wasted in a creamery above that actually required to drive the separator; that "the turbines use steam extravagantly, but that the small engine of the creamery uses it still more extravagantly." Due allowance must therefore be made for this waste in comparing results obtained by various methods of testing. The following table gives some of the results published by the stations:

Horse-power per 1000 lbs Milk.

Style of Separator.	Delaware.	New York.	Vermont.	Wisconsin.
Butter Accumulator	....	2.69	....	2.45
Columbia Cream Separator	....	3.17	....	
Reid's Improved Danish	....	....	1.83	1.52
De Laval Standard	....	....	......	2.12
" Alpha No. 1	. ... .	....	....	0.81
" Alpha Acme	... .	....	0.79	0.98
" Baby No. 2	0.37	....	....	0.46
" " No. 3	....	0.26	.... ..	
Jumbo	....	....	1.87	
United States No. 1	... .	....	1.37	1.12
" No. 3	....	0.76	......	0.63
" No. 5	....	....	....	0.72
Victoria, 700 lbs	....	2.78	....	
" 30 gals	0.74	.... ..	....	
" 20 gals	0.85	....	....	
De Laval Alpha Turbine	....	....	....	1.47 to 1.79
Sharples Imperial	....	......	....	1.42
" Russian	....	....	....	1.75 to 2.11

These tests are made with single machines and do not guarantee that all separators of the same makes consume

the same power or steam. The accumulating results of such trials being compiled, however, become a guide in estimating the value of the various machines in the market. As between belt and turbine (or direct steam) power, the former is preferable in large creameries. In small plants one is about as economical as the other, and the choice may depend upon whether an engine is needed for churning, butter-worker, pump, and other purposes, or you can do without it.

Capacity.—In selecting a separator it is best to have plenty of capacity. In a large creamery it is better to have two separators of moderate size than one very large machine. Only in very large creameries may separators of largest capacity be preferable. The capacity should be such as to finish the day's work in 4 to 6 hours at the time when there is most milk. In the private dairy, using a hand separator, the work should require only one hour, rather less. The following would be our idea of the proper capacity:

Largest Supply of Milk per Day, lbs.	Number of Machines.	Capacity of Each Machine, lbs. per hour.	Power.
15,000 or more...........	2 or more	2,000 to 2,500	Engine
10,000 to 15,000...........	2	1,500 " 2,000	"
7,500 " 10,000...........	2	1,200 " 1,500	"
5,000 " 7,500...........	2	1,000	Eng. or Turb.
2,500 " 5,000..........	1	1,200	" "
1,000 " 2,500..........	1	600 to 1,000	" "
500 " 1,000...........	1	600	Sheep, or dog, or turbine.
300 " 500.........	1	300 to 500	Hand, or dog, or sheep.
100 " 300...........	1	300	Hand
Less than 100..........	1	150	"

Condition of Cream.—As discharged from the separator, the cream should be smooth and even, free from froth and of perfect "churnability."

As to *cost*, *the best machine is always the cheapest* in the long run. Repairs, waste of fat in the skim-milk, of oil, and of coal, by an inferior machine, will more than make up any saving in first cost.

Running the Separator.

The Operator should understand his Business.—He should have thorough training in creameries as a helper and, if possible, in a dairy school, before undertaking to manage a creamery separator on his own responsibility. A new machine should be put up and started by the manufacturer or his agent, and prove in perfect shape and efficiency before he leaves. Every manufacturer gives detailed instructions as to the care of the separator, and such an instruction book should always be at hand. The operator of hand as well as of power machines should make himself familiar with every detail of the construction.

Condition and Temperature of the Milk.—Fresh and warm from the cow, the milk is in the best condition to be skimmed. If it cannot be had in that condition, it should be aerated and *cooled* on the farm, so that it arrives at the creamery or the dairy at not over 60°. Then reheat it to 80° or 85°, not under 75° and not over 90°. This heating is preferably done in some continuous heater, as it is dangerous to heat it in bulk, because milk standing some time at 85° is apt to spoil. While the separator will skim at a lower temperature, either the skimming is not clean or less milk must be run through the machine in the same time. Of course, the milk must be sweet.

Starting.—Oil all bearings thoroughly, using only the very best oil. Ascertain that everything is in trim order, then start according to instructions, which vary for different kinds of machines. Always start carefully, and where the belt from the intermediate is shifted from loose to fixed pulley, do it slowly and gradually, helping with the hand on the belt to start the bowl. When the bowl appears to be running at full speed without shaking, ascertain if it really does so by means of the *speed indicator*, which should always be found on any power machine.

Never allow the machine to run faster than permitted by the manufacturer. If you do, it is at your risk and at the risk of the lives of your assistants. Use the speed indicator often.

See that the feed of new milk is correct and that the *proportion of cream* to milk is as wanted. Hold a quart measure under the skim-milk spout and a measuring glass under the cream outlet, and, when the quart measure is full, see how much cream you have in the measuring glass, taking the time by your watch. If you have 6 ozs. of cream to 1 quart of skim-milk in 9 seconds, you have taken 6 parts of cream from 38 of new milk, or a little less than one sixth, or about 16%, and you are running at the rate of 950 lbs. per hour. How large a proportion of cream to take from the milk depends upon the richness of the milk and the consistency of cream desired. If you have 4% milk and you wish cream of 28% fat, you will take 1 part of cream from 7 of new milk, or 14% .

Keep the oil-cups filled and look frequently at all working parts of the machinery. Well started and regulated, it will run uninterrupted until all the milk is skimmed. When the last milk has entered the bowl, pour in sufficient skim-milk to crowd out all the cream left. If the skim-milk is removed from the building while the separator is running, *take samples frequently*, or, if it is all left after the work is done, take a few average samples to *test with the Babcock machine, so as to control the day's work.*

Stop the machine cautiously, removing the motive power and letting the bowl come to a stand-still of itself *without applying any brake.* Remove the skim-milk left in the bowl by a siphon or otherwise, take off the covers, etc., and lift out the bowl.

Cleaning.—First rinse the bowl and other parts which have been in contact with milk in cold or tepid water, and then scrub them in boiling water, frequently using some solution of sal-soda. Scrub and brush every corner. Rinse in clean boiling water and steam out the tin covers, etc. Wipe with a cloth and set the things to dry. Pump out every pipe that cannot be reached by hand and brush. If possible, *avoid the use of rubber hose* to conduct the milk from the vat or heater to the separator, but use open tin conductors or short tin pipes, which can be easily kept clean. Rubber hose cannot be washed in boiling water

or soda, and is a source of contamination. Clean the separator stand carefully with a cloth and wipe the spindles, etc. Occasionally *clean out the oil-chambers* with kerosene oil, and always see to it that no gum is formed and that the *oil-grooves and tubes* are open.

If the separator shakes, or in any way works imperfectly, find the cause without delay and remedy it. If you fail to find the fault, or you cannot remedy it yourself, notify the manufacturer or his agent, and have him attend to it at once.

Treatment of the Cream.—As the cream leaves the separator, it should at once be cooled to 50° or lower. This insures "body" in the butter, and should not be neglected, at least not unless the cream is thoroughly chilled after it is ripened, before churning.

LOSS OF BUTTER CAUSED BY INEFFICIENT SKIMMING.

If three-tenths of one per cent of fat is left in the skim-milk, instead of two-tenths, in a separator creamery receiving 1000 lbs. of milk a day, there will be a loss of about 340 lbs. of butter for the whole year, on the supposition that 1000 lbs. of milk yield 800 lbs. of skim-milk, and 1 lb. of butter contains .86 lbs. of fat. If the separation is still poorer, greater losses will be sustained, as will be seen in the table given below. (Friis.)

Lbs. of Milk per Day.	Excess of Fat Left in Skim-milk.			
	.05 per cent.	.10 per cent.	.20 per cent.	.30 per cent.
	Loss of Butter During Whole Year.			
1,000	170	340	680	1,020
2,000	340	680	1360	2.040
3,000	510	1020	2040	3.060
4,000	680	1360	2720	4.089
5,000	850	1700	3400	5,100
6,000	1020	2040	4080	6.120
7,000	1190	2380	4760	7.140
8,000	1360	2729	5440	8,160
9.000	1530	3060	6120	9,180
10,000	1700	3400	6800	10,200

RELATION OF FAT CONTENT OF SEPARATOR SKIM-MILK AND SPEED OF BOWL, QUANTITY OF MILK SEPARATED, AND TEMPERATURE OF THE MILK.

Fleischmann gives the following formula for ascertaining the fat content of separator skim-milk, f being the per cent fat in the skim-milk, M the quantity of milk skimmed per hour, u the speed of the bowl, and t the temperature of the milk:

$$f = c\,\frac{\sqrt{M}}{u^2} \times 1.035^{40-t}$$

c is a constant which must be determined for each machine; Hittcher found its value, in the case of three different machines, as follows: 480,152; 547,800; 363,430. The results obtained by the use of the formula seem to agree fairly well with chemical analysis of the skim-milk where care is taken in determining the various factors entering into the calculation.

STEAM BOILER AND ENGINE MANAGEMENT.

By Prof. A. W. Richter, of the University of Wisconsin.

Boiler.

Feed Apparatus.—Every boiler should be provided with a check-valve, placed between the feed apparatus and boiler, and in such a manner as to have the weight of the valve assist in closing it. Between this check-valve and boiler there should be an additional globe or gate-valve which may be closed, thus permitting repairing or cleaning of the check-valve while the boiler is in operation.

Water Supply.—Feed-water should enter a boiler in such a manner that the plates do not receive the direct impact of cold water. The usual practice is to have the feed enter through the blow-off pipe, thus preventing this pipe from clogging. The feed supply should be regulated so as to keep the water level as stationary as possible, The greatest care must be taken that the water level does not fall below the top of the flues. Neglect in this direction will cause the metal to become overheated and consequently weakened, causing leakage of joints and in-

creased wear and tear, but more often resulting in an explosion of a more or less serious nature.

Water-glass and Water-gauges.—Every boiler should have three water-gauges in addition to a water-glass; these are usually attached to a hollow cast-iron cylinder or tube connected with the water and steam spaces.

The water-glass should be blown out daily, and, if clogged, can be safely cleaned with a bent wire.

In no case should the water glass alone be depended upon to indicate the water level.

Steam-gauge.—Each boiler should be provided with a steam-gauge, which gauge should be directly connected with it.

Safety-valve.—Every boiler should be provided with a safety-valve having direct communication with the steam space, and moreover should there be an intervening valve. Some of the most disastrous explosions can be traced to faulty arrangement in this respect. The valve thoughtlessly left closed after cleaning or repairs prevents the safety-valve from relieving the pressure when it rises above the safe working pressure of the boiler.

Safety-valves are of two kinds: spring and lever safety-valves. Of the two valves the lever-valve has the most disadvantages, one of the most important being the ease with which it may be made useless by adding an additional weight to that already provided, in order to keep the valve on its seat, and therefore greatly increasing the pressure at which it will blow off.

A safety-valve should be raised each day by hand so as to allow steam to escape; this prevents clogging and rusting.

The dealer will usually set the spring-valve so that it will blow off at the desired pressure. It can be adjusted, however, by loosening or tightening a screw provided for that purpose.

The lever-valve may be set with the aid of the following formula:

$$l = \frac{bPA - Vb - wc}{W};$$

l = distance from weight to fulcrum;
b = " " valve centre to fulcrum;
c = distance from the centre of gravity of the lever of the fulcrum;

$P =$ boiler pressure;
$A =$ area of valve;
$V =$ weight of valve;
$w =$ " " lever,
$W =$ weight hung upon the lever.

Firing.—Firing should be gradual, and the grate kept completely covered with coal or ashes. The fire should not be more than four or five inches deep unless the pieces of coal are large, in which case the depth may be increased.

The fire-doors and flue-doors should not be opened in order to keep down the steam pressure. This practice not only wastes fuel but is injurious to the boiler, and will not be necessary if the boiler is properly attended to.

Priming or Foaming.—Foaming is a rapid disturbance of the water, in consequence of which it rises in the boiler in the form of spray or foam; it is usually caused by dirty water, presence of oil, etc., the boiler not having been cleaned for some time or not thoroughly cleaned. Foaming may, however, be due to other causes, such as too small a steam space, sudden demand of a great quantity of steam, etc. In case a boiler foams all steam connections should be shut off and the fire dampened by means of a fresh supply of live coal or ashes. These precautions will usually suffice to allow the water to settle, and to enable one to ascertain the true water level. If the glass shows a small amount of water, start the pump or injector, and fill the boiler to a point between the second and third gauge. The boiler may then be blown off to the first gauge by means of the surface blow-off, if one be present, and if not present the regular blow-off valve may be used. This operation being repeated, the impurities are gradually diminished, but care must be taken that the water level does not fall below the top of the flues. The boiler can now be used as before, but in all cases it should be thoroughly cleaned as soon as possible.

Removal of Scale.—Potatoes, about eight or ten in number, are sometimes placed in the boiler after cleaning. Soda or kerosene may also be injected with the feed-water in quantity to be determined by observation. Boiler compounds should be used with caution, and when used should be obtained from a reliable dealer. Too great a quantity of any of the above will be harmful.

Cleaning.—The interval during which a boiler requires no cleaning depends upon the quantity and the quality of water evaporated. Under usual conditions, in order to obtain the best results, a boiler should be cleaned every six or eight weeks.

If a boiler is to be cleaned it should be allowed to stand until it is partially cooled off. When blown out cold the metal in the interior will usually be found covered with a thick coating of soft deposit, which can easily be scraped off or washed off with a hose and stream of water.

If a boiler be blown off while the metal is at a high temperature, the deposited matter is usually baked and forms a solid and hard coating, increasing rapidly if not carefully removed by the process of chipping.

Boiler Power.—The manner in which the horse-power of a boiler is usually calculated is far from satisfactory, depending rather upon its size than its power of evaporation.

In 1884 the American Society of Mechanical Engineers adopted the following definite standard:

"A horse-power shall be equivalent to an evaporation of thirty pounds of water into dry steam per hour from feed-water at 100° Fahrenheit, and under a pressure of 70 lbs. per square inch above the atmosphere."

Steam-engine.—The engine should be provided with a governor to regulate its speed, a lubricator to oil valve and piston, and a sufficient number of oil cups, so that all bearings may be properly oiled.

Starting the Engine.—Before starting, all bearings should be supplied with oil, and all waste pipes connected with cylinder and steam-chest opened. The engine should then be started slowly, so as to allow the water to escape. A quantity of steam will always condense as it comes in contact with the cold cylinder-walls, in addition to the water already present in the steam-pipe. This water does not pass off as readily as steam, neither can it be compressed to any great extent. Therefore, if more water be present in the cylinder than will fill the clearance space, and this water not be allowed to escape, the piston moving towards the end of its stroke will strike the water, and consequently be compelled to stop. The greater the speed of the piston as it advances, the greater the force with which it strikes the water, resulting in many cases in a broken cylinder-head.

It is well to have a waste-pipe connected to the steam-pipe at a point just above the engine-valve, in order that the water which has collected in the steam pipe may be blown out before opening the steam-valve.

After the engine has been in operation for a minute or two the waste-valves should be closed.

Horse-power.—The horse-power of an engine may be calculated by means of the following formula:

$$\text{H. P.} = \frac{PLan}{33000};$$

H. P. = horse power;
P = mean effective pressure in the cylinder;
L = twice the length of the stroke, in feet;
a = area of piston in square inches;
n = number of revolutions per minute.

ON THE PRESERVATION OF MILK AND CREAM BY HEAT.

By Dr. H. L. Russell, of Wisconsin Experiment Station, Author of "Dairy Bacteriology".

On account of the innumerable bacteria that gain access to milk during the process of milking, and subsequent to that time, and the rapid increase of the same in this nutritious fluid, this material universally undergoes fermentative changes, the rapidity of which is largely dependent upon the surrounding temperature. To increase the keeping quality of milk, it is necessary to annihilate these bacteria or keep them under influences unfavorable to their growth.

Heat has been found to be the most efficacious agent in preserving milk in its natural condition. It is applied in two ways, viz., 1. *Pasteurization*, where the milk or cream is heated for a short time (20–30 min.) at a temperature near the coagulating point of the proteid constituents of the milk (150°–160° F.). 2. *Sterilization*, where the temperature approximates or exceeds the boiling-point and is applied for a longer time.

The object in both cases is to kill the bacteria present in the milk.

Sterilization accomplishes this most successfully, but it changes the proteid compounds so that the milk has an undesirable "cooked" flavor and odor.

This defect is not found in pasteurized milk, and if properly handled, milk treated by this process will remain sweet from 4 to 8 days.

For use in the near future the pasteurized product is, on the whole, the most satisfactory; the sterilized material being best adapted for export purposes.

The essential condition in pasteurization is that the pasteurizing temperature shall exceed the thermal death point (the temperature at which growing bacteria are destroyed) of disease-producing as well as fermentative bacteria. This temperature for most forms is about 140° F., but certain disease organisms like the tubercle germ of tuberculosis is not killed below 149° F. for 30 minutes, or 155° F. for 15 minutes. As this germ is often found in milk from tuberculous cows, prudence dictates the use of this temperature as a standard for the pasteurization of milk and cream. The proteids in the milk are slightly affected at this temperature, but if the milk is thoroughly chilled, the "cooked" flavor disappears.

The application of this temperature kills only the growing bacteria, and does not affect the latent spores. If after being heated the milk is allowed to cool slowly, and is left at a comparatively warm temperature (exceeding 55° F.), these spores germinate and soon change the character of the milk, so that the value of the heating process is lost. To be efficient, it is necessary to *rapidly* cool the pasteurized product below the germinating point of the spores, for if they are once allowed to sprout, they will develop slowly at a very low temperature.

In pasteurizing milk or cream, the apparatus should be constructed so that a definite quantity of the fluid can be held at any desired temperature for any length of time, and during the process protected from infection from the air. The apparatus must also be made so as to be easily cleaned and thoroughly sterilized by steam throughout. The milk must be protected from air infection during its withdrawal from the pasteurizing vat into storage vessels (cans and

bottles), and should be thoroughly chilled in a refrigerator for several hours (better over night) before being delivered to the consumer. This chilling process should succeed the heating operation as quickly as possible, as the sudden transition in temperature from 155° F. to 55° F. or less has a paralyzing effect on the development of those organisms (spores) that are not killed by the heat. A large number of machines have been put on the market, but they have for the most part been designed primarily from the dairyman's standpoint, and while they fulfill their requirements as to capacity, cheapness, etc., yet they cannot be relied upon to treat the milk in a way so as to free it with certainty from all possible disease-producing bacteria.

Pasteurization in this country is applied with great success to milk and cream where these products are used in the liquid form. It is used to some extent in this country, but much more widely in continental Europe, in the preparation of cream for the manufacture of butter by the use of a pure culture-starter. It can also be used advantageously in the hot months for increasing the length of time that by-products of the factory like skim-milk and whey may be preserved.

Pasteurization, as well as sterilization, reduces the body, consistency, of milk and cream, and these products therefore seem thinner after having been subjected to the process of heating than before. To obviate this, Dr. Babcock and the writer in 1896 recommended the addition of a small quantity of a solution of sucrate of lime ("viscogen") to the milk or cream, which will restore the consistency of the products, and in case of cream, greatly increase its whipping quality. (See Bull. No. 54 or thirteenth report of Wisconsin Experiment Station.)

DIRECTIONS FOR THE STERILIZATION OF MILK

(U. S. Dept. of Agriculture.)

The sterilization of milk for children, now quite extensively practised in order to destroy the injurious germs which it may contain, can be satisfactorily accomplished

with very simple apparatus. The vessel containing the milk, which may be the bottle from which it is to be used or any other suitable vessel, is placed inside of a larger vessel of metal, which contains the water. If a bottle, it is plugged with absorbent cotton, if this is at hand, or in its absence, other clean cotton will answer. A small fruit-jar loosely covered may be used instead of a bottle. The requirements are simply that the interior vessel shall be raised about half an inch above the bottom of the other, and that the water shall reach nearly or quite as high as the milk. The apparatus is then heated on a range or stove until the water reaches a temperature of 155 degrees Fahrenheit, when it is removed from the heat and kept tightly covered for half an hour. The milk-bottles are then taken out and kept in a cool place. The milk may be used any time within twenty-four hours. A temperature of 150 degrees maintained for half an hour is sufficient to destroy any germs likely to be present in the milk, and it is found in practice that raising the temperature to 155 degrees and then allowing it to stand in the heated water for half an hour insures the proper temperature for the required time. The temperature should not be raised above 155 degrees, otherwise the taste and quality of the milk will be impaired.

The simplest plan is to take a tin pail and invert a perforated tin pie-plate in the bottom, or have made for it a removable false bottom perforated with holes and having legs half an inch high to allow circulation of the water. The milk-bottle is set on this false bottom, and sufficient water is put into the pail to reach the level of the surface of the milk in the bottle. A hole may be punched in the cover of the pail, a cork inserted, and a chemical thermometer put through the cork, so that the bulb dips into the water. The temperature can thus be watched without removing the cover. If preferred an ordinary dairy thermometer may be used and the temperature tested from time to time by removing the lid. This is very easily arranged, and is just as satisfactory as the patented apparatus sold for the same purpose.

QUANTITY OF WATER OR ICE REQUIRED FOR COOLING MILK OR CREAM. (MARTINY.)

The quantity of water or ice required to cool milk or cream may be calculated from the following formulas, where

M = quantity of milk or cream to be cooled, in lbs.
t = its temperature.
W = quantity of water required for cooling, in lbs.
I = " " ice " " " " "
t' = temperature of water or ice at beginning.
T = end temperature of cooled milk or cream.
τ = end temperature of cooling water.
S = specific heat of milk (.84*) or of cream (.78*).
79.25 = latent heat of water.

(*a*) *Water required for cooling milk or cream*—

1. Cooled in tin cans holding milk or cream to be cooled:

$$W = \frac{(Mt - MT)S}{T - t'}$$

2. By application of coolers and running water:

$$W = \frac{(Mt - MT)S}{\tau - t'}$$

(*b*) *Ice required for cooling milk or cream*—

$$I = \frac{(Mt - MT)S}{T + t' \times 79.25}$$

In these formulas the influence of the surrounding air is not considered.

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* Not determined, but considered approximately correct.

IV. BUTTER.

BUTTER-MAKING.

By H. B. Gurler, De Kalb, Ill., ex-President Ill. State Dairymen's Assn., Author of "American Dairying."

Butter is made from milk. The cow manufactures the milk from the food she eats, hence the necessity of sound food. Unsound food makes off-flavored milk and poor butter. Some cows can manufacture food into milk at a profit, others cannot; hence the necessity of knowing the individuality of each cow, or her ability to work at a profit to her owner.

At this stage of the dairy work there is no excuse for a dairyman not knowing what each and every cow is doing for him, thus being able to "weed out" the unprofitable ones.

Be careful and cleanly in milking. Remove the milk to a pure atmosphere as soon as drawn from the cows. If the cream is raised by gravity process be careful of the surroundings, as milk will absorb bad odors from decayed vegetables, the hog-pen, the cow-yard, the kerosene-can, a filthy stable, from cooking in the kitchen, and various other sources.

When milk is put through the separator as soon as it is drawn from the cow this source of danger is removed. Cream from the separator should be cooled immediately to a temperature of 60°; 55° is better. A cooler that will ærate at the same time it is cooling is very desirable. This is a vital point which many butter-makers stumble over. When through separating and cooling, temper the cream to the temperature necessary to have it ripen at the time you wish to churn. If it is to be churned the following day this temperature should be 65°–70°. If the second day, 55°–60°; and if it is to stand four to seven days, cool to 40°, if possi-

ble, as soon as practicable, and hold at that temperature until the day before you wish to churn, when it should be warmed to a temperature that will give the right acidity by the time you wish to churn. This temperature will depend on the kind of cream, whether separator cream or cream from some gravity process. Cream from shallow setting may be sufficiently ripened when taken from the milk. I recommend the use of Prof. Farrington's acid tablets for testing the acidity of cream (see p. 239). They are a great help to a beginner.

Churn at as low a temperature as you can. This will depend on the per cent of fat in the cream. Rich cream can be churned at a much lower temperature than cream poor in fat. Cream from deep, cold setting may be churned at 58° to 62°; and thick, rich cream from shallow setting at a much lower temperature. An ironclad rule cannot be made that will fit all cases. The separator will give cream containing various per cent of fat, from 15 to 40 per cent. Separator cream containing 15 per cent fat will need to be churned at about the same temperature as deep, cold setting cream. Separator cream containing 40 per cent can be churned at a temperature of 50°, can be gathered at 50°, so the buttermilk will draw at that temperature. A low temperature gives the most exhaustive churning. At this temperature the buttermilk should contain no more fat than the average separator skim-milk. Cream containing a large per cent of fat does not develop acid as fast as cream with more milk in it. Cool cream for churning about two hours before, so as to let the butter-fat have time to solidify or harden. This gives a more waxy texture to the butter.

Stop the churn when the butter granules are the size of wheat. If the granules are too small there is danger of a loss from its passing through the strainer. Wash no more than is necessary to remove the buttermilk. The colder it is churned the less washing is needed. When butter gathers at 54° one washing is sufficient; if at 62° to 64°, two or three washings will be needed. Washing removes some of the delicate flavor or aroma. Remove the water from the churn as soon as possible—as soon as it has done its

work. Never allow it to lie and soak unless there is no other way of hardening the butter to a temperature where you can handle it.

Salt to suit your trade. Work once or twice, as you prefer; twice working is preferable, as it makes the nicer-appearing butter. Work just enough to remove the mottled or streaked appearance. When worked twice this can be told at the time by the appearance of the butter. When worked but once it cannot be told until the butter has stood long enough for the salt to dissolve. If worked but once examine the butter the following day, until you make yourself a rule of thumb to work by. I have found this necessary. I am compelled to look after this point in my creamery work when the butter is worked but once. Use the kind of butter-package that suits your trade, but always let it be *neat*. Never send a mussy-looking package to market. You cannot afford to do it.

ON THE USE OF PURE CULTURES IN BUTTER- AND CHEESE-MAKING.

The ripening of cream is brought about through the action of minute plants, so-called bacteria. These are practically omnipresent where man lives, and get into the milk during the milking and the handling of the milk and cream in the dairy. They multiply enormously in the cream during the ripening process, owing to the very favorable conditions of life which they find there. Some forms of bacteria are desirable and even essential in the manufacture of sour-cream butter; these feed largely on the milk-sugar of the cream, and decompose this component into lactic acid, which is the characteristic acid of sour cream (as well as of sour milk). Along with this formation of lactic acid in the cream other complicated, and yet but little understood, decomposition processes take place, the results of which are felt in the fine aromatic flavor of the butter produced. Other forms of bacteria cause obnoxious fermentations in the cream, and produce a butter of "off" flavor, in aggravated cases diseased butter, making the product unfit to eat, or at least

unsalable as a first-class article. The process of sour-cream butter-making is therefore, at the bottom, a question of keeping the fermentations during the ripening of the cream in the right track, of controlling the same so as to exclude all but lactic-acid-producing bacteria. The old original way of reaching this end was to allow the cream to sour spontaneously, trusting to luck to obtain the desired fermentation of the cream by leaving it standing in a warm room for a couple of days. Later on, a buttermilk starter from a preceding churning or a skim-milk starter was added for the purpose of ripening the cream ; by this means the lactic-acid bacteria contained in the starter were introduced in such large numbers that they generally were able to crowd out other kinds of bacteria that might be found in the cream, and which, if left alone, would produce undesirable fermentations in the cream and bad flavor in the butter. The next step in advance was the introduction of pure cultures of lactic-acid bacteria; these consist of one or a few forms of bacteria, and when introduced in milk or cream will be apt to overpower all other forms of bacteria therein, and thus produce the pure mild flavor of sour-cream butter desired.

The honor of having first introduced pure cultures in butter-making belongs to Dr. V. Storch, the chemist of the Danish state experiment station in Copenhagen; the bulletin describing Dr. Storch's investigations of this subject, "On the Ripening of Cream," was published in 1890. Other bacteriologists in Europe and in this country have worked along this same line, and as a result we find that pure cultures are at the present time used almost universally in the manufacture of sour-cream butter in the creameries and dairies of northern Europe, and also in this country their use has become general and is spreading. The expected result of adding a pure culture-starter, viz., that of excluding all undesirable fermentations in the ripening of the cream, will not, however, follow with any certainty unless the seeding with the pure culture is preceded by pasteurization or sterilization of the cream, that is, at least a partial destruction of the bacteria already found therein. In Europe, notably in Denmark and the

other Scandinavian countries, pasteurization of the milk (or of the cream) is practised regularly in all the best creameries, in the former country at present in perhaps 80 per cent of the creameries in operation. In this country the firms manufacturing and selling pure cultures have unfortunately not insisted on this point, and where pure culture-starters are used with us it is nearly always without previous pasteurization. One reason why pasteurization has not been adopted in the manufacture of butter in this country is that the market demands a higher flavored, "stronger" butter than is wanted by the European market, and the pure cultures on the market, when used with pasteurized cream, do not produce such a butter. The expense of pasteurization of the cream and the absence of proper apparatus, or non-introduction of such as have proved successful in European practice, furthermore tend to explain why our butter-makers do not generally pasteurize the cream in using pure culture-starters.

The two pure cultures now on the market in this country are Chr. Hansen's Lactic Ferment and Conn's culture (B. 41, Conn Culture Co., Waterloo, Ia., and Conn Butter Improvement Co., Philadelphia, Pa.). The former is of Danish origin, and is one of the standard pure cultures used in the Scandinavian countries; the latter was described by its originator in the author's Dairy Calendar for 1896. Both these cultures are placed on the market in dry form, the one as a powder, the other as pellets. Directions for using the cultures accompany each package sold. In general, the method to be followed is to seed the culture in a quantity of sterilized skim-milk or cream; this is kept for one to two days at a temperature below 90° (B. 41 70°, Lactic Ferment 86°); the starter is then mixed with the cream to be ripened, generally adding about 2 per cent. The cream will be ready for churning the next day. A portion of the starter prepared is used for the seeding of a new lot of sterilized skim-milk, which will make the starter for the following day, and the same process is continued until deterioration of the starter sets in, as shown by lack of flavor in the ripened cream and in the butter; a fresh batch is then prepared from a new package of ferment. If proper

care in sterilizing the skim-milk and in handling the starter is taken, the pure culture may be propagated in this manner for months. With lack of cleanliness and care it must be renewed every other week or oftener.

While the use of pure cultures has not as yet become general in American creameries, the agitation caused by their introduction and the discussions in dairy papers and dairy meetings which they have brought about have doubtless been of great benefit to our dairy industry in emphasizing in the minds of butter-makers the necessity of thorough cleanliness in the creamery and the importance of the proper conduct of the ripening process for the manufacture of high-grade butter. They have enabled us to make butter of uniform fine flavor and of greater keeping quality than was previously possible.

Where abnormal fermentations appear, and the butter produced is diseased or "off flavor," the evil may be remedied by the use of pure cultures. In case of the establishment of an export trade of American butter of high quality, the pure cultures used in connection with previous pasteurization of the milk or cream will prove of great benefit, insuring uniform goods and perfect keeping quality in the product.

The use of pure culture-starters in the manufacture of Cheddar cheese is of recent date, and but limited experience has so far been gained in this line. According to the testimony of some of our leading cheese-makers, and of recent experiments conducted at Wisconsin experiment station, their use for this purpose is very beneficial, cheese of improved, clean flavor and high keeping qualities being produced. Pure cultures may therefore be safely recommended for this purpose. The general method of application is similar to that followed in the manufacture of pure culture butter. The starter is propagated in sterilized milk and kept at 90° F. for one day, when it will be slightly lobbered, having an acidity of about .8 per cent. Mr. Decker of the Wis. Dairy School gives the following hints on the use of the starter by the cheese-maker:

"The starter is introduced into the milk by rubbing it

through a fine hair sieve so as to break up curd particles. If too large quantities of starter is used, there is a tendency to produce a sour cheese. The best results are obtained when a 2 per cent starter, of the acidity given, is added.

"In propagating the starter from day to day care must be taken to keep it free from contamination. It should always be prepared in a covered vessel that has previously been sterilized, and the milk used should first be pasteurized (or sterilized) and chilled before adding the 'seed.' Some of the original starter should be taken for 'seed,' not the whole milk after the starter has been added.

"The starter cannot be used for cheese-making if the milk is overripe, which is the case when the rennet test is 65 seconds or under (see p. 251). In sweet milk, testing by the rennet test 120 seconds, the addition of a 2 per cent starter will increase the acidity, so that the rennet test will act in 70 seconds.

"With sweet milk the use of a pure lactic starter will result in the saving of 3–5 hours in time. With tainted milk in which the acid develops imperfectly the addition of the starter aids in producing the acidity required for the manufacture of Cheddar cheese."

BOYD'S PROCESS OF CREAM RIPENING.

By John Boyd, Chicago, Ill.

It is an accepted fact that the fine aromatic flavor and also the keeping properties of butter depend largely upon the treatment of the cream from the time it is separated from the milk until it is ready for the churn, that is, in the best possible condition to yield the maximum quantity and the best quality as to flavor, texture, solidity, etc., free from casein and other undesirable substances. This perfect condition of cream is understood by the term "ripened cream," and when this condition can be produced by the butter-maker with uniformity, regardless of the seasons of the year or extremes of climate, the process may be reckoned as nearly perfect as possible, and not until then. It is most desirable that the process be as sim-

ple as possible, in fact within the reach of every creamery and dairyman in the country, and all the means required to attain these results can and should be a part of every dairy and creamery, large or small.

Boyd's process or system of ripening cream or milk is the result of years of practical work in a private dairy of about 40 Jersey cows. After it had been thoroughly tested and used, during all the seasons of the year, it was patented in the United States, Canada, and Great Britain, and given to the public in the year 1889, a very considerable time in advance of any of the artificial methods of ripening, now being advocated under the representations of "pure cultures of bacteria."

When first introduced it was met by a sea of opposition from the experts, who would see nothing good in it, but gradually it has been making its way in a quiet manner into popularity until at present it is being successfully practised in every state in the Union, and is gaining favor every day with the most practical butter-makers.

The apparatus necessary to practise the process supplies all the conditions required to produce a uniform result every day in the year, the temperature of the lactive ferment and also of the cream being entirely under the control of the operator during the entire process.

The directions for using the process, which go with every purchase of the apparatus, are as follows:

To make the Best Ferment.—Take milk from fresh-milking cows (that from pregnant cows will not answer); submerge the milk warm from the cows in Cooley cans in ice water. Skim at twelve or twenty-four hours, as most convenient, and use this skimmed milk for making the ferment; or select milk as above, run it through a separator, and save the skimmed milk for making the ferment.

The skimmed milk so selected is then brought to a temperature of 90°, in a water bath, being constantly stirred during the operation of heating. As soon as the temperature of the milk reaches 90°, place it in the fermenting-can and close the cover tightly, having first rinsed out the can with warm water. Allow the can to remain closed for

twenty or twenty-four hours, when the ferment will be found thick and in the proper condition for mixing with the cream or milk to be ripened.

How to use the Ferment.—First bring the cream or milk in the vat to a temperature of 66° to 70° Fahrenheit, when the ferment is to be thoroughly mixed with the cream or milk in the proportion of 2 per cent of the ferment to the amount of cream or milk to be ripened. Remove one or two inches of the top of the ferment, which is not desirable to use, and strain the rest through a fine strainer or hair sieve into the milk or cream. The finer the ferment is broken up the more effective its operation will be. After the cream or milk and ferment are well stirred and mixed at the above temperature, the vat must be closed and allowed to remain undisturbed until the cream is ripened, requiring from twenty to twenty-four hours for the operation; the cream when ripe will be found thick, mildly acid, and in the proper chemical condition, requiring only to be cooled to the proper temperature for churning.

Churning.—The best temperature for churning depends so much upon circumstances that the range is very wide, from 55° to 68° Fahrenheit. The richer the cream in butter-fat the colder the temperature should be, and the more milk the cream contains the higher the churning temperature should be. After the cream or milk and ferment are mixed, no more stirring is admissible, as any agitation of the cream afterwards retards the ripening process.

Butter by Shallow-pan Creaming.—Raise the cream in a temperature of about 60° F.; avoid as much as possible skimming milk in with the cream; ripen at about 65° F.; churn at 60° to 62°. Free the granules of butter from the buttermilk by washing in water, temperature about 55°. Salt, 1 oz. to 1 lb. of butter.

Butter by Deep Cold Setting and Cooley System.—Raise the cream in ice-water; milk may be skimmed in with the cream or not as desired; with the Cooley cream a very considerable portion of milk added to the cream will produce no bad effects. Ripen at a temperature of 68° by adding lactive ferment; churn at temperature of 58° to 65°;

wash the granules in water, temperature 50° to 55°, and salt as above.

Butter from Separator Cream.—Cool the cream from separator to 66° to 68°, add lactive ferment, and churn at 55° to 58°, according to the percentage of butter-fat in the cream. The cream should be cooled after ripening so that the temperature of the cream will register not over 55°. This cooling requires time and patience, but will be rewarded with solid granules. Wash in water at 50° to 52°. Salt, 1 oz. to 1 lb. of butter.

Good butter should not contain more than 16% of water (and may contain as little as 8%) when properly worked. It is sufficiently worked when it presents a delicate elasticity to the touch, and when broken should show a perfect uniformity of grain and color.

THE ALKALINE TABLET TEST OF ACIDITY IN MILK OR CREAM.

By Prof. E. H. FARRINGTON, of Wisconsin Dairy School.

Since this test was first described by the author, a number of changes have been made in the way of using it.

Reliable results are now obtained with less and simpler apparatus than when the test was originally published. At the present time it is used for two purposes.

First.—For testing the acidity of milk. To detect those lots which are apparently sweet, but too nearly sour for pasteurizing, for retailing, or for making the best butter or cheese.

Second.—For testing the acidity of each lot of cream during its ripening, to trace the progress of its souring, and to show whether the fermentations should be hastened or checked in order to have the cream in a certain acid condition at a given time and ready for churning.

In addition to the tablets, the only apparatus necessary for testing the acidity of either milk or cream is a common white teacup, a 4, 6 or 8 oz. bottle, and a No. 10 brass cartridge-shell or similar measure. The testing solution is

prepared by dissolving one tablet in one ounce of water. This is the standard. Four ounces of the tablet solution are made by filling a four-ounce bottle with water and adding to it four tablets. The No. 10 shell is filled with the milk or cream to be tested. This measured quantity is poured into the white cup. The same measure is then filled with the tablet solution and this is poured into the cup. The two liquids are thoroughly mixed and the color of the mixture is noted. If there is no change of color, another measure of tablet solution is added. This is continued until the sample which is being tested becomes of a pink color. As soon as the pink color is obtained no more tablet solution is added. The per cent of acid in the sample tested is found from the number of measures of tablet solution it is necessary to add to one measure of the sample in order to produce the pink color. Each measure of tablet solution represents one tenth of one per cent acid.

A more exact testing of acidity can be made by using a 20-cc. pipette for measuring the milk or cream to be tested and a 50-cc. graduated cylinder for the tablet solution.

Five tablets are dissolved in 50 cc. of water in the cylinder, and this solution is gradually poured into the 20 cc. of milk or cream in the white cup. When sufficient tablet solution has been added to produce the pink color in the sample tested, the operator observes on the scale of the graduated cylinder the number of cc. tablet solution used and from this calculates the per cent of acid in the sample tested. Each cc. of this tablet solution is equal to 0.0034 gr. lactic acid, and when 20 cc. of a sample is tested, each cc. of the tablet solution is equal to .017 per cent acid in the sample.

Milk does not smell or taste sour until it contains from three to four tenths of one per cent acid. It has been found, however, that milk containing over two tenths per cent acid cannot be safely pasteurized, because such milk sours very soon. These tablets supply a quick means of selecting the sweetest of different lots of sweet milk, by showing which contain less than two tenths of one per cent acid.

Cream is often ripened so far that the quality of the butter is injured. The usual method of the butter-maker for testing the sourness of the cream is by the sense of smell and taste. A tablet test shows exactly what per cent of acid each lot of cream contains, so that the butter-maker is better able to manufacture a uniform grade of butter by ripening his cream to the same point before it is churned. Sweet cream contains about 0.15% acid. Cream has reached the proper point for churning when it contains about six-tenths per cent acid. As the souring of cream is largely influenced by the temperature at which it is held, the butter-maker is able to know from an acid test of the cream whether it should be warmed or cooled in order to have it ready for churning at a given time and just sour enough for making butter of good flavor.

DIRECTIONS FOR THE USE OF MANNS' TEST FOR ASCERTAINING THE ACIDITY OF CREAM.

1. Stir the cream thoroughly; insert small end of pipette in cream and draw until nearly full; then put the finger over upper end of pipette and allow cream to escape slowly (by admitting air) until mark on neck of pipette is reached. Transfer to a tumbler, rinse the pipette three times with lukewarm water, adding the rinsing water to the cream in the tumbler. Now add to contents of the tumbler three drops of the solution marked "Indicator" (phenolphtalein).

2. Fill the burette up to the 0 mark with the solution marked "Neutralizer" (alkali solution).

3. While constantly stirring the cream with the glass rod, allow the liquid to flow from the burette into the tumbler until the entire contents of the tumbler shows a pink tinge. Stop adding the solution from the burette the moment the color is permanent.

4. Read the level of the liquid remaining in the burette. The reading shows the amount of acid present.

The experience of those using the test indicates that where the acidity of the cream is right, to secure the best results in yield and flavor of butter, from 38 to 42 cc. of the neutralizer will be required for the test. It is a simple

matter for each butter maker to learn by experiment the exact degree of acidity and churning temperature suited to the best results, and with these as standards reduce the process of butter-making to a certainty. By testing his cream in the afternoon the butter-maker will be able to set it to ripen at such a temperature that it will show the proper acidity for churning next morning.

In testing the milk for cheese-making the same directions are to be followed, excepting that a much less acid condition is required; probably 15-20 cc. will give the best results. The whole numbers are cubic centimeters; the intermediate divisions are fractions of a cubic centimeter.

Precautions in Using the Test.—The solution marked "Neutralizer" is prepared of a certain strength. It is essentia that this strength remain constant. Never let this solution stand without a stopper. Keep in glass or stoneware.

PERCENTAGE COMPOSITION OF BUTTER. (König.)

	Average.	Minimum.	Maximum.	Sweet Cream Butter.	Sour Cream Butter.
No. of analyses included	302			10	11
Water	13.59	4.15	35.12	12.93	13.08
Fat	84.39	69.96	86.15	84.53	84.26
Casein	.74	.19	4.78	.61	.81
Milk sugar	.50 }	.45	1.16	.68	.66
Lactic acid	.62 }			....	....
Ash	.66	.02	15.08	1.25	1.19
	100.00				

AVERAGE CHEMICAL COMPOSITION OF SWEET CREAM- AND SOUR CREAM-BUTTER.

(Fleischmann.)

	Made from Sweet Cream, not Salted.		Made from Sour Cream, Salted.	
	Not washed.	Washed.	Not washed.	Washed.
	Per ct.	Per ct.	Per ct.	Per ct.
Water	15.00	15.00	12.00	12.50
Fat	83.47	83.73	84.75	84.62
Casein and albumen	.60	.55	.50	.48
Other organic substances	.80	.60	.55	.40
Ash, or ash and salt	.13	.12	2.20	2.00

ANALYSES OF PREMIUM BUTTERS, FAT-STOCK SHOW, CHICAGO, 1889.—IN PER CENT. (MORROW.)

Description of Samples.	Total Score.*	Water.	Fat.	Curd.	Ash.†
1. Sweepstakes—Creamery, gathered cream...	96	9.99	85.41	1.01	3.58
2. " " whole milk........	94	12.19	82.66	1.21	3.93
3. " Dairy......	93	8.49	86.53	.86	4.12
4. " From a grade cow....	95.5	9.71	85.96	1.03	3.29
5. First prize—From a Jersey cow	91	8.99	88.08	.79	2.13
6. " " From a Shorthorn cow.........	91	12.07	84.79	1.34	1.79
7. " " From an Ayrshire cow	93	9.53	86.53	.81	3.32
8. " " From a Devon cow...	87	10.78	86.20	.72	2.29
9. " " From a Holstein cow...........	92.5	10.56	85.53	.88	3.03
Average...........	92.5	10.23	85.74	.96	3.05

PERCENTAGE COMPOSITION OF EUROPEAN SAMPLES OF BUTTER.

	Schleswig-Holstein.	Danish.	Swedish.	French.		Italian.	German Preserved Butter.	English.
				Salted.	Un-salted.			
Number of samples analyzed.	28	12	40	5	78	15	24	50
Water................	11.99	13.35	13.84	12.05	13.73	15.33	12.22	11.64
Fat........	85.47	83.40	84.35	84.34	84.82	83.00	85.68	86.93
Casein, milk-sugar, lactic acid, etc.	1.19	1.39	1.23	1.60	1.36	1.47	1.26	.60
Salt....	1.35	1.86	.58	2.01	.09	.20	.84	.83

FORMULA FOR CALCULATING THE YIELD OF BUTTER.

In ordinary dairy or creamery practice, where modern methods of creaming and churning are applied, the yield of butter will exceed that of fat in the milk by 15 to 16 per cent, or 1 pound of fat in the milk will produce about 1.15 pounds butter, i.e., yield of butter from 100 lbs. of milk = $1.15f$, f being the per cent of fat in the milk.

Fleischmann's formula:

$$\text{Yield of butter} = 1.16f - .25$$

* The standard of the scale of points in a total of 100 was: Flavor, 45; grain, 30; color, 15; salting, 10.

† Chiefly salt.

Conversion Factor for Calculating Yield of Butter from the Amount of Butter-fat.—The following resolution was passed by the Association of American Agricultural Colleges and Experiment Stations at the annual convention of the association, July, 1895:

"Resolved, That this association recommends to the several stations that the results of tests of dairy cows or herds be expressed in terms of butter-fat, and that when desirable to express these records in terms of approximate equivalent in butter such equivalent be computed by multiplying the amount of butter-fat by $1\frac{1}{6}$." (Report of Curtiss, Armsby, and Cooke.)

The factor $1\frac{1}{6}$ is based upon the results of the Columbian dairy test, in which it was found that on the average 117.3 lbs. of butter were made from each 100 lbs. of butter-fat in the whole milk.

AMOUNT OF BUTTER OBTAINED FROM 100 LBS. OF CREAM OF DIFFERENT RICHNESS. (Martiny.)

Per Ct. Fat in Cream.	Yield of Butter.	Per Ct. Fat in Cream.	Yield of Butter.	Per Ct. Fat in Cream.	Yield of Butter.
	lbs.		lbs.		lbs.
15	34.5	22	50.6	29	66.7
16	36.8	23	52.9	30	69.0
17	39.1	24	55.2	31	71.3
18	41.4	25	57.5	32	73.6
19	43.7	26	59.8	33	75.9
20	46.0	27	62.1	34	78.2
21	48.3	28	64.4	35	80.5

YIELD OF BUTTER FROM MILK OF DIFFERENT RICHNESS. (Kirchner.)

100 lbs. of milk will yield the number of pounds of butter given in the table. (Percentage creaming, 16 per ct.; fat in butter, 83 per ct.)

Per cent. of Fat in Milk.	Per cent. of Fat in Skim-milk.			
	.20	.30	.40	.50
2.5	2.697	2.600	2.503	2.406
2.6	2.812	2.716	2.618	2.522
2.7	2.928	2.832	2.734	2.638
2.8	3.044	2.948	2.850	2.754
2.9	3.160	3.063	2.966	2.869
3.0	3.276	3.178	3.081	2.984
3.1	3.392	3.293	3.297	3.100
3.2	3.508	3.409	3.313	3.216
3.3	3.624	3.525	3.429	3.332
3.4	3.739	3.641	3.544	3.447
3.5	3.854	3.757	3.659	3.562
3.6	3.969	3.873	3.774	3.677
3.7	4.084	3.989	5.890	3.793
3.8	4.200	4.105	4.006	3.909
3.9	4.316	4.220	4.122	4.025
4.0	4.432	4.335	4.238	4.141
4.1	4.547	4.450	4.352	4.257
4.2	4.663	4.565	4.468	4.373
4.3	4.779	4.681	4.584	4.489
4.4	4.895	4.797	4.700	4.604
4.5	5.011	4.913	4.816	4.719
4.6	5.127	5.028	4.932	4.834
4.7	5.243	5.144	5.048	4.949
4.8	5.359	5.260	5.164	5.065
4.9	5.474	5.376	5.280	5.181
5.0	5.589	5.492	5.395	5.297

POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF BUTTER.

Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.
2.8	31.1	5.0	17.4
3.0	29.0	5.2	16.7
3.2	27.2	5.4	16.1
3.4	25.5	5.6	15.5
3.6	24.2	5.8	15.0
3.8	22.9	6.0	14.5
4.0	21.7	6.2	14.0
4.2	20.7	6.4	13.6
4.4	19.8	6.6	13.2
4.6	18.9	6.8	12.8
4.8	18.1	7.0	12.4

Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.
10	8.70	26	3.34
11	7.90	27	3.22
12	7.25	28	3.11
13	6.69	29	3.00
14	6.21	30	2.90
15	5.80	31	2.81
16	5.44	32	2.72
17	5.12	33	2.64
18	4.83	34	2.56
19	4.58	35	2.48
20	4.35	36	2.42
21	4.14	37	2.35
22	3.95	38	2.29
23	3.78	39	2.23
24	3.62	40	2.17
25	3.47		

The two preceding tables are based on ordinary creamery experience, 1 pound of fat in the milk producing 1.15 pounds of butter.

NUMBER OF POUNDS OF MILK REQUIRED FOR MAKING ONE POUND OF BUTTER. (Kirchner.)

Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.	Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.
2.4	41.67	3.8	26.32
2.5	40.00	3.9	25.64
2.6	38.46	4.0	25.00
2.7	37.04	4.1	24.39
2.8	35.71	4.2	23.81
2.9	34.48	4.3	23.26
3.0	33.33	4.4	22.73
3.1	32.26	4.5	22.22
3.2	31.25	4.6	21.74
3.3	30.30	4.7	21.28
3.4	29.41	4.8	20.83
3.5	28.57	4.9	20.41
3.6	27.68	5.0	20.00
3.7	27.03	5.5	18.18

DISTRIBUTION OF MILK INGREDIENTS IN BUTTER MAKING. (Cooke.)

	Total Solids.	Fat.	Casein.	Albumen.	Milk Sugar.	Ash.	Proportion of the Total Milk Fat found in the Product.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1000 lbs. of whole milk....	130.0	40.0	26.0	7.0	49.5	7.5	..
800 lbs. of skim-milk. ...	78.0	2.4	22.0	6.0	41.2	6.4	6
200 lbs. of cream..	52.0	37.6	4.0	1.0	8.3	1.1	94
187 lbs. of buttermilk.....	14.91	.8	3.77	.94	8.3	1.1	2
43.3 lbs. of butter........	37.09	36.8	.23	.06	....	....	92

SCORE FOR JUDGING BUTTER.

	World's Fair, Chicago, 1893.
Flavor...........................	45
Grain...........................	25
Color...........................	15
Salting...........................	10
Packing...........................	5
	100

This score has been adopted in judging butter exhibits at various State fairs and dairymen's conventions during late years; in some cases the score has been changed to 50 for flavor and 5 for salting, otherwise as above, or to flavor 40, grain 30, with other points as above.

Minimum number of points entitling exhibitors to a premium:

Wisconsin Dairymen's Association, 93, 95, and 94 points, for dairy, separator creamery, and gathered-cream butter, respectively.

New York State Fair, 75 points.

ENGLISH SCALE OF POINTS FOR JUDGING BUTTER. (McConnell.)

Perfection, 100.

25 Flavor: nutty, aromatic, sweet.
20 Moisture: as free from beads of water as possible.
10 Solidity: firm, not melting easily, nor softening.
25 Texture: closeness of grain, distinct fracture; not greasy.
10 Color: natural, even.
10 Make: remaining points, cleanliness, salting, nicely put up, etc.
—
100

SCORE IN JUDGING PROFICIENCY OF BUTTER-MAKERS.

(Adopted by British Dairy Farmers' Association.)

Butter-making.

Preparation of cream	4	Salting	5
" " utensils	6	Making up	15
Ventilation of churn	4	Flavor and color	7
Judgment and skill in churning	15	Texture and freedom from moisture	7
Washing butter in churn	10	Cleaning utensils	4
Use of strainer	4	Rapidity and cleanliness of working	5
" " thermometer	7		
" " butter-worker	7		
			100

AMERICAN SCORE FOR JUDGING PROFICIENCY OF BUTTER-MAKERS.

(Proposed by F. W. CULBERTSON.)

	Points.
Preparation and temperature of cream	8
Straining cream and use of strainer	5
Color and flavor	6
Judgment and skill in churning and butter-working	18
Butter in granular form	8
Washing butter in churn	7
Salting	5
Use of thermometer	5
Making up and neatness of package	10
Grain and quality of butter	7
Cleaning utensils: churn and worker	7
Airing churn	3
Testing buttermilk	3
Neatness of person and cleanliness of work	8
Perfection	100

V. CHEESE.

HOW AMERICAN CHEESE IS MADE.

By John W. Decker, of Wisconsin Experiment Station, Author of "Cheddar Cheese Making."

A. Factory or Cheddar Cheese.

As soon as the milk is received at the factory it is heated to 86° F. and a rennet test made.*

If the milk is not ripe enough it is held till the proper acidity is reached. If the milk is very sweet a starter of sour milk is added to hasten it. The milk should be set at such a ripeness that there will be one eighth of an inch of acid (fine strings) on the hot-iron in two hours and a half from the time rennet is added.

If the cheese is to be colored the color is added just before setting the milk. When it is thoroughly stirred in, we can add the rennet. The amount of rennet to be used depends on the kind of cheese desired. If a soft fast-curing cheese is wanted, enough rennet is used to coagulate the milk in fifteen to twenty minutes; if a slow-curing cheese, enough to coagulate in thirty to forty-five minutes. It is stirred in thoroughly in four or five minutes and then the dipper is run lightly over the top, to keep the cream down till the milk begins to thicken, when a cloth cover is spread over the vat and the coagulation allowed to continue till the curd will break clean over the fingers.

* The *Marschall* rennet test is recommended. It consists of a 160 cc. tin cylinder for measuring the milk, a 5 cc. pipette, a 50 cc. graduated flask, and a half-pint tin basin. The rennet is measured with the 5 cc. pipette and delivered into the 50 cc. flask, the rennet adhering to the pipette being rinsed into the flask with a little water. The flask is then filled with water to the 50 cc. mark, and the solution mixed by shaking. The milk, the temperature of which should be 86° F., is measured in the tin cylinder, emptied into the half-pint basin, and 5 cc. of the dilute extract is measured into the 160 cc. of milk, and the number of seconds required to curdle it noted. If a few specks of charcoal are scattered on the milk and the milk started into motion around the dish with a thermometer, the instant of curdling can be noted by the stopping of the specks. They will stop so suddenly as to seem to start back in the opposite direction. The *Marschall* rennet test is a very convenient device for ascertaining the exact moment of coagulation.

The curd is then cut, using the horizontal knife first and cutting lengthwise of the vat. The cutting is finished from this point with the perpendicular knife, the curd being thus cut into cubes one half inch in diameter.

Without waiting for the curd to settle, we begin stirring very carefully with a wire basket, and rub the curd off from the sides of the vat with the hand. As soon as this is done we turn on the heat carefully and raise the temperature slowly to 98° F.; when the curd is firm enough a wooden rake is used to stir it. The temperature is raised at the rate of one degree in four or five minutes.

As soon as the temperature of 98° F. is reached we begin trying the curd on the hot-iron for acid. We must have the curd firm enough when the whey is drawn, so that a double handful pressed together will fall apart readily. This is the test for a proper cooking. When fine threads one eighth of an inch in length show on the hot iron the whey is ready to draw. This should be two and a half hours from the time the milk was set. The whey is drawn off by means of a whey gate and a whey strainer, and the curd dipped into a curd-sink or on racks placed in the vat. There should be racks in the curd-sink over which a linen strainer-cloth is thrown. The curd is dipped onto this cloth and the whey drains through. The curd should be stirred, to facilitate the escape of the whey, and is then left to mat together. In fifteen or twenty minutes it can be cut into blocks eight or ten inches square, and turned over. After turning several times these blocks can be piled two or three deep. The acid will continue to develop in the curd; when it will string about an inch it will have assumed a stringy or meaty texture, so that it will tear like the meat on a chicken's breast.

It is then run through the curd-mill and cut up into small pieces. These pieces are stirred up every little while to air. In the course of another hour and a half there will be two inches of acid on the curd; it will smell like toasted cheese when pressed against the hot-iron, and when a handful is squeezed, half fat and half whey will run out between the fingers. It is then ready to salt. It is cooled to 80° F. be-

fore salting. If a fast-curing cheese is wanted we use two pounds per hundred pounds of curd; two and a half pounds are used for a medium cheese, and three pounds for a slow-curing cheese. The curd should be spread out at an even thickness and the salt applied evenly. It should then be thoroughly stirred several times.

As soon as the harsh feeling has left the curd it is ready to go to press. The screw should be turned slowly, but fast enough so that a stream of brine is kept flowing. The full pressure should not be applied for ten minutes. In an hour the bandages can be turned down, and full pressure is then applied. The continuous-pressure gang-press made by D. H. Burrell and Co., is the most satisfactory, as the cheese will not loosen during the night. The next day the cheese are placed on the shelves and the rinds greased. They should be turned and rubbed every day. The temperature of the curing-room should be 60° to 65° F., and moisture should be supplied in dry weather. The cheese are boxed and shipped in about a month.

B. Cheese Made on the Farm.

For a farm dairy it will be much easier to make up sweet-curd cheese than sour-curd cheese, described in the preceding. For this purpose it is necessary to have a curd-knife, a cheese-vat, and a cheese-press; the method of procedure is as follows:

The milk, which must be clean and sweet, is heated to 90° F., and if any artificial color is required it is added at this time. Set the milk with enough rennet extract to coagulate in 20 to 30 minutes. About four ounces of Hansen's rennet extract per 1000 lbs. of milk will prove a sufficient amount.

As soon as the curd will break over the finger cut it fairly fine; then raise the temperature one degree in 3 minutes until 108° F. is reached, at the same time stirring carefully to keep the curd particles apart. Hold at 108° F. till the curd is firm, that is, till the pieces do not feel mushy. Then draw the whey and stir till the whey is well drained out. Salt at the rate of 2½ lbs. of salt to 100 lbs. of curd, and when the salt is well worked in put it to press. The cheese should be cured in a room (preferably a cellar)

where the temperature can be kept at 60° F., otherwise it will spoil. The cheese should be cured for two to three months before it is sold.

CAUSES OF TAINTED MILK.

The causes of tainted milk have been classified as follows, by the Swiss scientist, Dr. Gerber:

1. Poor, decayed fodders, or irrational methods of feeding.
2. Poor, dirty water, used for drinking-water or for the washing of utensils.
3. Foul air in cow-stable, or the cows lying in their own dung.
4. Lack of cleanliness in milking; manure particles on udder.
5. Keeping the milk long in too warm, poorly ventilated and dirty places.
6. Neglecting to cool the milk rapidly, directly after milking.
7. Lack of cleanliness in the care of the milk, from which cause the greater number of milk taints arise.
8. Poor transportation facilities.
9. Sick cows, udder diseases, etc.
10. Cows being in heat.
11. Mixing fresh and old milk in the same can.
12. Rusty tin pails and tin cans (Böggild).

THE FERMENTATION TEST.

At cheese factories there is often, especially during hot summer weather, a need of some test to discover the cause of abnormal fermentations which show themselves in tainted, pinholey, gassy, or floating curds. The trouble will generally be found to lie in the milk furnished by one or a few patrons who do not properly care for their milk, or who allow diseased or tainted milk of any kind to be mixed with the milk sent to the factory. The problem then is to detect the origin of the "off" milk, so as to refuse taking it and thus prevent it spoiling the whole day's make of cheese. The experienced careful cheese-maker will be apt to find out such milk from its odor or general appearance when pouring it into the weighing-can, but it may some-

times escape attention. The *Gerber* fermentation test (modified by *Monrad*) furnishes a convenient method for discovering tainted milk. The test consists of a tin tank which can be heated by means of a small lamp, and into which a rack fits holding a certain number of cylindrical glass tubes; these are all numbered and provided with a mark and a tin cover. In making the test the tubes are filled to the mark with milk, the number of each tube being recorded in a notebook opposite the name of the particular patron whose milk was placed therein. The tubes in the rack are put in the tank, which is two thirds full of water; the temperature of the water is kept at 104–106° F. for six hours, when the rack is taken out, the tubes gently shaken, and the appearance of the milk, its odor, taste, etc., carefully noted in each case. The tubes are then again heated in the tank at the same temperature as before for another six hours, when observations are once more taken of the appearance of the milk in each tube. The tainted milk may then easily be discovered on account of the abnormal coagulation of the sample.

Gerber concluded from over 1500 tests made by this method:

1. That good and properly handled milk should not coagulate in less than 12 hours, nor show anything abnormal when coagulated.

2. If it does, it shows the milk to be abnormal, either on account of its chemical composition or because it is impregnated with too much ferment (rather, abnormal ferments, causing an undesirable fermentation).

3. Milk from sick cows, cows that are strongly in heat, or cows with diseased udders will always coagulate in less than 12 hours.

4. Only about 20 per cent of the tests coagulated within 12 hours.

Monrad proposes the following rules for the adoption of this test by cheese factories:

1. "A proper journal is kept of all the tests.

2. "The patrons whose milk is tainted have to pay the cost of making the test.

3. "The patrons whose milk is tainted will be kept track of, and in case there is any loss caused thereby they will have to stand it.

4. "Patrons having tainted milk shall be notified at once, and another test made three days later. If then the milk is still bad, a test of each cow's milk is made on the farm and otherwise the reason sought to be discovered, and until then the milk will be refused."

Another test published in the twelfth report of Wisconsin Experiment Station will prove very satisfactory for the purpose of detecting gas-producing bacteria in milk. The method, which calls for no special apparatus aside from a number of pint fruit-jars, is operated as follows:

"Pint milk-bottles are sterilized in order to kill out any adherent germ-life, and then filled two-thirds full with milk from each patron. To each of these is added a definite amount of rennet extract (ten drops), and the bottles then immersed in warm water (98°–100° F.). After the milk has set, the curd is cut and cooked in the usual manner. The whey is then poured off and the curds are allowed to mat, their condition being noted from time to time. In this way the normal conditions practised in cheese-making are adhered to quite closely, so that practically the various stages of making Cheddar cheese up to the point of putting to press is carried out, and the development of gas in the curds can be noted with exactness. Observations are usually recorded after the lapse of about 4–6 hours and then again on the following day."

DETERMINATION OF HUMIDITY IN CHEESE-CURING ROOMS.

The proper degree of humidity in the cheese-curing room will vary with different kinds of cheese and at different stages of the curing process. Green cheese should be placed in a somewhat drier curing-room than older; the latter kinds, according to Fleischmann, require a relative humidity of 90°–95°, against 85°–90° for green cheese.

Kirchner states that the humidity of curing-rooms should not, in general, go below 80° or above 95°. Temperatures from 50°–70° F. are preferable in the curing-room.

The following temperatures and percentages of humidity are recommended by Martiny:

	Deg. Fahr.	Per Cent Humidity.
(*a*) *For hard cheeses* (Swiss, etc.).		
Green	59–63	90–95
Half cured	54–59	85–90
Cured	50–54	80–95
(*b*) *For soft cheeses* (Limburger, etc.)	50–59	80–95

In the interior of our continent it is somewhat difficult to obtain as much moisture in the air of curing-rooms as is represented by the preceding figures; the relative humidity of ordinary curing-rooms in this region, therefore, but rarely goes over 60°. A higher degree of humidity may be obtained by hanging wet sheets of canvas in the curing-room (Decker), or by similar devices, as described in the thirteenth ann. report of Wis. Experiment Station.

Self-recording thermometers are to be recommended for use in curing-rooms. For observation of relative humidity a wet and dry bulb thermometer, a Mittchoff's hygrometer, or a Lambrecht's polymeter may be used to advantage. Any of these instruments may be obtained through dealers in chemical glassware or dairy supplies; the prices range from $8 to $30.

TABLE SHOWING THE RELATIVE HUMIDITY IN THE AIR OF CURING-ROOMS. (King.)

Directions.—Notice that the table is in three column sections. Find air temperature in first column, then find wet-bulb temperature in second column, same division. In third column opposite this is relative humidity.

Example.—Air temperature is 50°, in first column; wet-bulb is 44°, in second column, same division. Opposite 44° is 61, which is the per cent of saturation, or the relative humidity of the air.

Caution.—Fan the bulb briskly for a minute or two before taking reading.

Dry Bulb.	Wet Bulb.	Rel. Hum.
40	32	37
	33	44
	34	52
	35	59
	36	68
	37	76
	38	84
	39	92
41	32	31
	33	38
	34	46
	35	53
	36	60
	37	68
	38	76
	39	84
	40	92
42	33	33
	34	40
	35	47
	36	54
	37	61
	38	69
	39	77
	40	84
	41	92
43	33	28
	34	34
	35	41
	36	48
	37	55
	38	62
	39	70
	40	77
	41	85
	42	92
44	34	29
	35	36
	36	43
	37	49
	38	56
	39	63
	40	70
	41	78
	42	85
	43	92

Dry Bulb.	Wet Bulb.	Rel. Hum.
45	35	31
	36	37
	37	44
	38	50
	39	57
	40	64
	41	71
	42	78
	43	85
	44	92
46	35	26
	36	32
	37	38
	38	45
	39	51
	40	58
	41	65
	42	72
	43	79
	44	85
	45	93
47	36	28
	37	34
	38	40
	39	46
	40	52
	41	59
	42	66
	43	72
	44	79
	45	86
	46	93
48	37	29
	38	35
	39	41
	40	47
	41	53
	42	60
	43	66
	44	73
	45	79
	46	86
	47	93
49	38	30
	39	36
	40	42

Dry Bulb.	Wet Bulb.	Rel. Hum.
49	41	48
	42	54
	43	60
	44	67
	45	73
	46	80
	47	86
	48	93
50	39	32
	40	37
	41	43
	42	49
	43	55
	44	61
	45	67
	46	74
	47	80
	48	87
	49	93
51	40	33
	41	39
	42	45
	43	50
	44	56
	45	62
	46	68
	47	74
	48	81
	49	87
	50	93
52	41	35
	42	40
	43	46
	44	51
	45	57
	46	63
	47	69
	48	75
	49	81
	50	87
	51	94
53	41	31
	42	36
	43	41
	44	47
	45	52

Dry Bulb.	Wet Bulb.	Rel. Hum.
53	46	58
	47	63
	48	69
	49	75
	50	81
	51	87
	52	94
54	42	32
	43	37
	44	42
	45	48
	46	53
	47	59
	48	64
	49	70
	50	76
	51	82
	52	88
	53	94
55	43	33
	44	38
	45	43
	46	49
	47	54
	48	59
	49	65
	50	70
	51	76
	52	8[illegible]
	53	88
	54	94
56	44	34
	45	39
	46	44
	47	50
	48	55
	49	60
	50	65
	51	71
	52	77
	53	82
	54	88
	55	94
57	45	36
	46	40
	47	45

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.
	48	50
	49	55
	50	61
	51	66
57	52	71
	53	77
	54	83
	55	88
	56	94
	46	37
	47	42
	48	46
	49	51
	50	56
58	51	61
	52	67
	53	72
	54	78
	55	83
	56	89
	57	94
	47	38
	48	43
	49	47
	50	52
	51	57
59	52	62
	53	67
	54	72
	55	78
	56	83
	57	89
	58	94
	48	39
	49	44
	50	48
	51	53
	52	58
60	53	63
	54	68
	55	73
	56	78
	57	84
	58	89
	59	94
	49	40
	50	44
	51	49
	52	54
61	53	58
	54	63
	55	68
	56	73
	57	78

Dry Bulb.	Wet Bulb.	Rel. Hum.
	58	84
61	59	89
	60	94
	50	41
	51	45
	52	50
	53	54
	54	59
62	55	64
	56	69
	57	74
	58	79
	59	84
	60	89
	61	95
	51	42
	52	46
	53	51
	54	55
	55	60
63	56	64
	57	69
	58	74
	59	79
	60	84
	61	89
	62	95
	52	43
	53	47
	54	51
	55	56
	56	60
64	57	65
	58	70
	59	74
	60	79
	61	85
	62	90
	63	95
	53	44
	54	48
	55	52
	56	56
	57	61
65	58	65
	59	70
	60	75
	61	80
	62	85
	63	90
	64	95
66	53	40
	54	45

Dry Bulb.	Wet Bulb.	Rel. Hum.
	55	49
	56	53
	57	57
	58	61
	59	66
66	60	71
	61	75
	62	80
	63	85
	64	90
	65	95
	54	41
	55	45
	56	49
	57	53
	58	58
	59	62
67	60	66
	61	71
	62	76
	63	80
	64	85
	65	90
	66	95
	55	42
	56	46
	57	50
	58	54
	59	58
	60	63
68	61	67
	62	71
	63	76
	64	81
	65	85
	66	90
	67	95
	56	43
	57	47
	58	51
	59	55
	60	59
	61	63
69	62	67
	63	72
	64	76
	65	81
	66	86
	67	90
	68	95
	57	44
70	58	48
	59	52
	60	55

Dry Bulb.	Wet Bulb.	Rel. Hum.
	61	60
	62	64
	63	68
	64	72
70	65	77
	66	81
	67	86
	68	90
	69	95
	58	45
	59	48
	60	52
	61	56
	62	60
	63	64
71	64	68
	65	72
	66	77
	67	81
	68	86
	69	91
	70	95
	59	45
	60	49
	61	53
	62	57
	63	61
	64	65
72	65	69
	66	73
	67	77
	68	82
	69	86
	70	91
	71	95
	60	46
	61	50
	62	53
	63	57
	64	61
	65	65
73	66	69
	67	73
	68	78
	69	82
	70	86
	71	91
	72	95
	61	47
	62	50
	63	54
74	64	58
	65	62
	66	66

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum	Dry Bulb	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
	67	70		63	48		72	78		69	60
	68	74		64	52		73	83		70	64
	69	78		65	55	77	74	87		71	68
74	70	82		66	59		75	91		72	71
	71	86		67	63		76	95	79	73	75
	72	91		68	66					74	79
	73	95	76	69	70		65	49		75	83
				70	74		66	53		76	87
	62	47		71	78		67	56		77	91
	63	51		72	82		68	60			
	64	55		73	87		69	63		66	47
	65	58		74	91	78	70	67		67	51
	66	62		75	95		71	71		68	54
	67	66					72	75		69	57
75	68	70		64	49		73	79		70	61
	69	74		65	52		74	83		71	64
	70	78		66	56		75	87	80	72	68
	71	82	77	67	59		76	91		73	72
	72	87		68	63					74	75
	73	91		69	67		66	50		75	79
	74	95		70	71	79	67	53		76	83
				71	74		68	57		77	87
										78	92

SCORE FOR JUDGING CHEESE.

	World's Fair 1893.	New York, 1894.		Wisconsin Dairymen's Assoc. 1894.
		For Export.	For Home Trade.	
Flavor	45	45	50	45
Texture (and body)	20	30	25	30
Color	15	15	15	15
Salting	10	..	..	..
Make up (finish)	10	10	10	10
	100	100	100	100

ENGLISH SCALE OF POINTS FOR JUDGING CHEESE. (McConnell.)

Perfection, 100.

35 Flavor: nutty, buttery.
25 Quality: mellow, rich, melting on tongue.
15 Texture: solid, compact.
15 Color: natural-like, even.
10 Make: remainder, due to good making, as cleanliness, salting, perfect rind, etc.

100

PERCENTAGE COMPOSITION OF CHEESE. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Nitrogen—free Extract.	Ash.
Cream cheese..	27	36.33	40.71	18.84	1.02	3.10
Full cream cheese	143	38.00	30.25	25.35	1.43	4.97
Half-skim cheese	21	39.79	23.92	29.67	1.79	4.73
Skim cheese.	41	46.00	11.65	34.06	3.42	4.87
Sour-milk cheese	15	52.36	16.03	36.64	.90	4.07
Whey cheese	7	23.66	16.91	8.90	45.75	4.78

VARIETIES AND ANALYSES OF CHEESE.

(McConnell.)

	Water.	Casein.	Fat.	Sugar.	Ash.
British, pressed—	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Cheddar, 3 months	36.17	24.93	31.83	3.21	3.86
" 6 "	31.17	26.31	33.68	4.91	3.93
" average	34.38	26.38	32.71	... ...	3.58
Cheshire, new	36.96	24.08	29.34	5.17	4.45
" old	32.59	32.51	26.06	4.53	4.31
Derby	31.68	24.50	35.20	4.38	4.24
Dunlop	38.46	25.87	31.86	....	3.81
Gloucester (single)	32.50	28.51	28.23	....	4.66
" (double)	35.96	21.74	26.83	....	4.07
British, soft—					
Cream	30.65	4.94	62.99	....	1.15
Stilton	30.35	28.85	35.39	....	3.82
French, soft—					
Brie	50.35	17.18	25.12	....	5.41
Camembert	50.16	21.85	21.13	....	3.89
Gervais (cream)	52.94	11.80	20.75	2.58	2.93
Neufchatel	44.47	14.60	33.70	....	2.99
French, pressed—					
Gruyere	34.87	25.87	28.91	... .	3.84
Roquefort	31.20	27.63	33.16	....	6.01
Dutch—					
Edam (round)	36.28	24.06	30.26	....	4.90
Gouda (flat)	21.90	46.95	24.81	....	6.32
German—					
Backstein	73.10	19.80	2.80	2.20	2.10
Swiss—					
Backstein	35.80	24.44	37.40	....	2.36
Bellelay (soft)	37.59	28.88	30.05	....	3.48
Emmenthaler	35.14	30.86	31.00	....	4.00
Italian—					
Gorgonzola	44.04	28.06	29.84	....	3.87
Parmesan	31.34	41.99	19.22	....	6.25
Various—					
American factory	25.93	38.12	31.55	......	4.38
Foreign skim, average	46.08	33.37	10.54	6.12	3.81
German sour milk	63.63	25.27	4.85	....	3.67
Whey cheese (cow)	24.21	9.06	20.80	41.01	4.92
" " (goat)	25.29	9.10	20.98	29.21	3.88
Centrifugal skim-milk cheese	50.5	43.1	1.2	.... ..	5.2

DISTRIBUTION OF INGREDIENTS IN CHEESE-MAKING. (Cooke.)

	Total Solids.	Fat.	Casein and Albumen.	Milk-sugar.	Ash.
	Per cent	Per cent	Per cent	Per cent	Per cent
Cheese..........	54.2	90.6	77.4	5.0	36
Cheese-press drips...	.9	.4	.6	1.5	1
Whey................	44.9	9.0	22.0	93.5	63
	100.0	100.0	100.0	100.0	100

DISTRIBUTION OF FERTILIZING INGREDIENTS IN CHEESE-MAKING. (Cooke.)

	Nitrogen.	Phosphoric Acid.	Potash.
	lbs.	lbs.	lbs.
1000 lbs. of whole milk........	5.30	1.90	1.75
900 lbs. of whey................	1.35	1.23	1.63
100 lbs. of cheese....	3.95	.65	.12

FORMULAS FOR FINDING YIELD OF CHEDDAR CHEESE.

The approximate yield of green cheddar cheese from 100 lbs. of milk may be found by multiplying the per cent of fat in the milk by 2.7; if f designate the per cent of fat in the milk, the formula will therefore be:

$$\text{Yield of cheese} = 2.7f.$$

The factor 2.7 will only hold good as the average of a large number of cases. In extensive investigations during three consecutive years Van Slyke found that the number of pounds of green cheese manufactured for one pound of fat in the milk varied from 2.51 to 3.06, the average figures being 2.73, 2.71, and 2.72, for 1892–94, respectively. For cured cheese the factor will be somewhat lower, viz., about 2.6 on the average.

If the percentage of solids not fat and of fat in the sample of milk are known, the following formula, published by Dr. Babcock in the twelfth report of the Wisconsin Ex-

periment Station, will give close results (s = solids not fat; f = fat):

$$\text{Yield of green cheese} = 1.58(\tfrac{1}{3}s + .91f).$$

This formula is based on a water content of 37 per cent in the cheese; it may be readily changed to suit any particular per cent. The average percentages of water in green cheese in Van Slyke's investigations referred to above were 36.41, 37.05, and 36.70 per cent for the years 1892–94, respectively.

If the percentages of casein and fat in the milk are both known, the yield of cheese may be calculated from the following formula, which will give fairly correct results:

$$\text{Yield of cheese} = 1.1f + 2.5 \text{ casein.} \qquad \text{(Babcock.)}$$

YIELD OF DIFFERENT KINDS OF CHEESE FROM 100 LBS. OF MILK. (Fleischmann.)

	Green Cheese.	Cured Cheese.
	lbs.	lbs.
Soft full-cream cheese intended for immediate consumption	25–33	....
Very soft full-cream cheeses (Brie, Camembert, Neufchatel, etc.)	18–22	12–15
Somewhat firmer, full-cream soft cheeses (Limburger, Remondon cheese, etc.)	13–16	9–11
Soft half-skim cheese (Limburg), 1¼ lbs. butter and	12–13	9–11
Soft skim cheeses (*à la* Brie, Camembert, Livarot. Backstein, etc.), 3–3.4 lbs. butter and	7.5–12	6.5–9
Roquefort cheese (made from sheeps' milk)	18	12–14.5
Full-milk, from American and English cheeses, and .75 lbs. whey-butter.	9–11	8–9
Full-milk from Dutch and Swiss cheeses and .75 lbs. whey-butter.	8–11	7–10
Half-skim firm cheeses, 1.6 lbs. butter and	7–10	5–8
Skim-milk cheese, 3–3.5 lbs. butter and	5–7	4–6
Sour-milk cheese, 3–3.5 lbs. butter and	7.5–9	5–6
Scandinavian "Gammelost" and 3–3.5 lbs. butter.	3.5–5.5	2–3
Whey cheese ("Mysost") and butter and skim-milk cheese.	6–7	....

Whey in manufacture of full-cream cheese, 73–88 lbs., average 81 lbs.
" " " " half-skim " 72–80 " " 76 "
" " " " skim cheese 66–76 " " 71 "

Under similar conditions 5–7 lbs. less of whey are obtained in the manufacture of soft cheese than in that of firm cheese.

The *loss* sustained in the manufacture of cheese amounts on the average to 3 lbs. per 100 lbs. of milk, not considering the losses incurred in the curing of the cheese.

AVERAGE LOSS OF AMERICAN CHEDDAR CHEESE IN CURING. (Babcock.)

No. of Group.	Period Covered.	Average Age.	No. of Cheese.	Total Weight Green.	Total Weight Cured.	Loss.	
	Days.	Days.		Lbs.	Lbs.	Lbs.	Per Cent.
1	1–10	6	99	2,812	2,741.5	70.5	2.51
2	11–20	16	242	7,356.9	7,077.0	279.9	3.80
3	21–30	25	298	8,530.5	8,160.4	370.1	4.34
4	31–60	41	417	12,353.3	11,684.4	668.9	5.41
5	Over 60	141	172	6,244.4	5,736.0	508.4	8.11

Total number of cheese in preceding trials ....1235.
Average weight of green cheese ....30.2 lbs.
" temperature of curing-room.....61° F. (range 55–70°).
" humidity of air in curing-room........ 50 per cent.

LOSS IN WEIGHT OF DIFFERENT KINDS OF CHEESE DURING CURING. (Martiny.)

			Per Cent.
Swiss (Emmenthal)—			
made from whole milk will lose in........	5	months	8–14
" " half-skimmed milk will lose in	8	"	15–20
" " skim-milk will lose in........	6	"	12–15
Tilsit—			
made from whole milk will lose in........	4	"	12–25
Dutch (Gouda)—			
made from whole milk will lose in........	3	"	20–28
" " skim " " " "........	4	"	15–25
American Cheddar—			
made from whole milk will lose in........	2	"	5
" " " " " " "........	4	"	6–7
Limburger or Remoudon—			
made from whole milk will lose in........	2½	"	16–28
Brick cheese—			
made from skim-milk will lose in........	2½	"	15–30
Camembert, Brie, Neufchatel, etc.—			
made from whole milk will lose in........	2	"	20–35
Sour-milk cheese—			
made from whole milk will lose in.......	3½	"	50–60

YIELD OF CHEESE FROM 100 LBS. OF MILK and Relative Cheese Value of Milks Corresponding to Per Cent of Fat and Readings of Quevenne Lactometer at 60° F.
(BABCOCK.)

Yield of cheese $= 1.58\left(\frac{T-F}{3} + 91F\right)$.
(In large type—1, 2, 3, etc.)

Relative cheese value of milks $= \frac{1}{5}\left(\frac{T-F}{3} + 6F\right)$.
(In small type—1, 2, 3, etc.)

Per Cent of Fat.	Lactometer Degrees.											Per Cent of Fat.
	26	27	28	29	30	31	32	33	34	35	36	
3.0	8.05 / 4.07	8.18 / 4.09	8.31 / 4.10	8.45 / 4.12	8.58 / 4.14	8.71 / 4.15	8.84 / 4.17	8.97 / 4.19	9.11 / 4.21	9.24 / 4.22	9.37 / 4.24	3.0
3.1	8.21 / 4.19	8.34 / 4.21	8.47 / 4.22	8.60 / 4.24	8.74 / 4.26	8.87 / 4.27	9.00 / 4.29	9.13 / 4.31	9.26 / 4.33	9.39 / 4.34	9.53 / 4.36	3.1
3.2	8.36 / 4.31	8.49 / 4.33	8.62 / 4.34	8.75 / 4.36	8.89 / 4.38	9.02 / 4.39	9.15 / 4.41	9.28 / 4.43	9.42 / 4.45	9.55 / 4.46	9.68 / 4.48	3.2
3.3	8.52 / 4.43	8.65 / 4.45	8.78 / 4.46	8.91 / 4.48	9.05 / 4.50	9.18 / 4.51	9.31 / 4.53	9.44 / 4.55	9.57 / 4.57	9.70 / 4.58	9.84 / 4.60	3.3
3.4	8.67 / 4.55	8.80 / 4.57	8.93 / 4.58	9.06 / 4.60	9.20 / 4.62	9.33 / 4.63	9.46 / 4.65	9.59 / 4.67	9.73 / 4.69	9.86 / 4.70	9.99 / 4.72	3.4
3.5	8.82 / 4.68	8.96 / 4.70	9.09 / 4.71	9.22 / 4.73	9.35 / 4.75	9.48 / 4.76	9.62 / 4.78	9.75 / 4.80	9.88 / 4.82	10.01 / 4.83	10.15 / 4.85	3.5
3.6	8.98 / 4.80	9.11 / 4.82	9.24 / 4.83	9.37 / 4.85	9.50 / 4.87	9.63 / 4.88	9.77 / 4.90	9.90 / 4.92	10.03 / 4.94	10.17 / 4.95	10.30 / 4.97	3.6
3.7	9.13 / 4.92	9.26 / 4.94	9.39 / 4.95	9.52 / 4.97	9.65 / 4.99	9.78 / 5.00	9.92 / 5.02	10.05 / 5.04	10.19 / 5.06	10.32 / 5.07	10.46 / 5.09	3.7
3.8	9.29 / 5.04	9.42 / 5.06	9.55 / 5.07	9.68 / 5.09	9.81 / 5.11	9.94 / 5.12	10.08 / 5.14	10.21 / 5.16	10.34 / 5.18	10.48 / 5.19	10.61 / 5.21	3.8
3.9	9.44 / 5.16	9.57 / 5.18	9.70 / 5.19	9.84 / 5.21	9.97 / 5.23	10.10 / 5.24	10.23 / 5.26	10.36 / 5.28	10.50 / 5.30	10.64 / 5.31	10.77 / 5.33	3.9
4.0	9.60 / 5.29	9.73 / 5.31	9.86 / 5.32	10.00 / 5.34	10.13 / 5.36	10.26 / 5.37	10.39 / 5.39	10.53 / 5.41	10.66 / 5.43	10.79 / 5.44	10.93 / 5.46	4.0
4.1	9.75 / 5.41	9.88 / 5.43	10.02 / 5.44	10.15 / 5.46	10.28 / 5.48	10.39 / 5.49	10.54 / 5.51	10.68 / 5.53	10.81 / 5.55	10.94 / 5.56	11.08 / 5.58	4.1

4.2	9.90	10.03	10.17	10.30	10.43	10.57	10.70	10.84	10.97	11.10	11.24	4.2
	5.53	5.55	5.56	5.58	5.60	5.61	5.63	5.65	5.67	5.68	5.70	
4.3	10.06	10.19	10.32	10.45	10.58	10.72	10.85	10.99	11.12	11.25	11.39	4.3
	5.65	5.67	5.68	5.70	5.72	5.73	5.75	5.77	5.79	5.80	5.82	
4.4	10.21	10.34	10.48	10.61	10.74	10.87	11.00	11.14	11.27	11.41	11.55	4.4
	5.77	5.79	5.80	5.82	5.84	5.85	5.87	5.89	5.91	5.92	5.94	
4.5	10.36	10.49	10.63	10.76	10.89	11.03	11.16	11.29	11.42	11.56	11.70	4.5
	5.89	5.91	5.92	5.94	5.96	5.97	5.99	6.01	6.03	6.04	6.06	
4.6	10.52	10.65	10.78	10.92	11.05	11.18	11.31	11.45	11.58	11.71	11.85	4.6
	6.02	6.04	6.05	6.07	6.09	6.10	6.12	6.14	6.16	6.17	6.19	
4.7	10.67	10.81	10.94	11.07	11.20	11.34	11.47	11.60	11.73	11.87	12.01	4.7
	6.14	6.16	6.17	6.19	6.21	6.22	6.24	6.26	6.28	6.29	6.31	
4.8	10.83	10.96	11.09	11.22	11.36	11.49	11.62	11.76	11.89	12.02	12.16	4.8
	.26	6.28	6.29	6.31	6.33	6.34	6.36	6.38	6.40	6.41	6.43	
4.9	10.98	11.11	11.25	11.38	11.51	11.65	11.78	11.91	12.04	12.18	12.32	4.9
	6.38	6.40	6.41	6.43	6.45	6.46	6.48	6.50	6.52	6.53	6.55	
5.0	11.14	11.27	11.40	11.54	11.67	11.80	11.93	12.07	12.20	12.34	12.48	5.0
	6.50	6.52	6.53	6.55	6.57	6.58	6.60	6.62	6.64	6.65	6.67	
5.1	11.29	11.42	11.55	11.69	11.82	11.96	12.09	12.23	12.36	12.49	12.63	5.1
	6.62	6.64	6.65	6.67	6.69	6.70	6.72	6.74	6.76	6.77	6.79	
5.2	11.45	11.58	11.71	11.85	11.98	12.11	12.24	12.38	12.52	12.66	12.80	5.2
	6.74	6.76	6.77	6.79	6.81	6.82	6.84	6.86	6.88	6.89	6.91	
5.3	11.60	11.73	11.86	11.99	12.13	12.27	12.40	12.53	12.67	12.71	12.85	5.3
	6.86	6.88	6.89	6.91	6.93	6.94	6.96	6.98	7.00	7.01	7.03	
5.4	11.76	11.89	12.02	12.16	12.29	12.42	12.55	12.69	12.83	12.97	13.01	5.4
	6.98	7.00	7.01	7.03	7.05	7.06	7.08	7.10	7.12	7.13	7.15	
5.5	11.91	12.04	12.17	12.31	12.44	12.58	12.71	12.85	12.99	13.12	13.25	5.5
	7.10	7.12	7.13	7.15	7.17	7.18	7.20	7.22	7.24	7.25	7.27	
5.6	12.07	12.20	12.33	12.47	12.60	12.73	12.87	13.00	13.14	13.28	13.41	5.6
	7.23	7.25	7.26	7.28	7.30	7.31	7.33	7.35	7.37	7.38	7.40	
5.7	12.22	12.35	12.48	12.52	12.75	12.89	13.02	13.16	13.30	13.44	13.57	5.7
	7.35	7.37	7.38	7.40	7.42	7.43	7.45	7.47	7.49	7.50	7.52	
5.8	12.38	12.51	12.64	12.77	12.91	13.05	13.18	13.31	13.45	13.59	13.72	5.8
	7.47	7.49	7.50	7.52	7.54	7.55	7.57	7.59	7.61	7.62	7.64	
5.9	12.53	12.66	12.79	12.93	13.06	13.19	13.33	13.47	13.60	13.74	13.87	5.9
	7.59	7.61	7.62	7.64	7.66	7.67	7.69	7.71	7.73	7.74	7.76	
6.0	12.69	12.82	12.95	13.09	13.22	13.35	13.49	13.62	13.75	13.89	14.02	6.0
	7.71	7.73	7.74	7.76	7.78	7.79	7.81	7.83	7.85	7.86	7.88	

SYNOPSIS OF MANUFACTURE OF PRINCIPAL VARIETIES OF CHEESE. (McConnell.)

	Evening's Milk Cooled to	Rennetted at	Time Allowed for Coagulation	Temperature in Cooking.	Breaking or Stirring.	Acid Developed.	Salt Added.	Pressure Applied.	Ripened at	Mold.	Shape of Cheese.	Weight of Cheese.	Remarks.
	° F.	° F.	Min.	° F.	Min.				° F.			lbs.	
Cheddar...........	68	84	45	100	100	Much	1:56	1 ton	60	......	Deep	60–80	
Cheshire—													
Early ripening...	70	80	50	90	30	V'ry much	1:25	15 cwt.	60	......	"	80	50% more rennet used; skewered; sour whey added, 1:120.
Medium " ...	68	87	60	92	40	Medi'm	1:30	Graduated	60	......	"	80	Dried in oven at 70–80° F.
Late " ...	66	90	70	94	40	Little	1:35	"	60	......	"	80	" " " " " "
Stilton...........	65	86	45	None	Little	"	1:40	56 lbs.	60	Green	"	20	Open, flaky curd desired; extra renn[illegible]
Stilton.............	65	85	60–150	"	Very little	"	1:60	None	65	Blue	"	15	Extra cream added, or ⅛ skim drawn off.
Gloucester (single and double)......	65	80	60	84	"	"	Outside	Graduated	65	"	Flat	15&30	Partly skim-milk; painted brown; differ only in thickness.
Wilts Loaf.........	65	80	60	90	Little	"	1:56	"	65	......	Deep	30	Partly skim-milk.
Derby..	63	80	60	None	"	None	Outside	"	63	Blue	Flat	30	" sweet curd.
Leicester...........	65	82	70	84	20	Little	1:160	"	65	......	"	40	
Dunlop.............	65	80	60	None	60	None	1:56	"	60	......	Medi'm	56	No scalding; curd broken by hand.
Brie................	......	83	240	"	None	"	Outside	None	50	Blue	Flat	4–5	Drained in open moulds.
Camembert.........	......	86	240	"	"	"	"	"	50	White	Deep	1	Drained in open moulds; ripe in six weeks.
Cantal.	......	75	60	"	15	"	Little	Much	46	......	Flat	40–100	Ripe in two months.
Coulommiers	......	78	720	"	None	"	None	None	...	Green	"	2½	Drained in open moulds.
Gervais (cream)....	......	65	720	"	"	"	"	"	....	......	Deep	¼	Drained in cloth; 1 cream to 2 milk; 1 drop rennet to quart of milk.
Gorgonzola.........	......	90	20	"	"	"	Outside	"	46	Blue	"	40–60	Drained in cloths
Parmesan..........	......	92	45	130	40	Medi'm	"	Little	50	......	Flat	150	Ripens in three years.

WHEY TO BE ALLOWED AT CHEESE FACTORIES FOR QUANTITIES OF MILK FROM 30 TO 360 POUNDS. (Robertson.)

The figures in the columns denote the inches of whey.

Weight of Milk in Pounds.	Diameters of Milk-cans in Inches.								
	20	19	18	17	16	15	14	13	12
30	2	2	3	3	3	3	4	5	6
35	2	3	3	3	3	4	5	6	7
40	3	3	3	4	4	5	6	6	7
45	3	4	4	4	4	5	6	7	8
50	3	4	4	5	5	6	7	8	9
55	4	4	5	5	6	7	8	9	10
60	4	5	5	6	6	7	8	9	11
65	4	5	5	6	7	8	9	10	12
70	5	5	6	7	7	8	10	11	13
75	5	6	6	7	8	9	10	12	14
80	5	6	7	8	8	10	11	12	15
85	6	6	7	8	9	10	12	13	16
90	6	7	7	9	9	11	12	14	17
95	6	7	8	9	10	11	13	15	18
100	7	7	8	9	10	12	14	16	19
105	7	8	9	9	11	13	15	16	19
110	7	8	9	10	11	13	15	17	20
115	8	9	10	10	12	14	16	18	21
120	8	9	10	11	12	14	17	19	22
125	8	9	10	11	13	15	17	19	23
130	9	10	11	12	13	16	18	20	24
135	9	10	11	12	14	16	19	21	
140	9	10	12	13	14	17	20	22	
145	10	11	12	13	15	17	20	23	
150	10	11	12	14	15	18	21	24	
155	10	11	13	15	16	19	22		
160	11	12	13	15	16	19	22		
165	11	12	14	16	17	20	23		
170	11	12	14	16	17	20	23		
175	12	13	15	16	18	21	24		
180	12	13	15	17	18	22	24		
185	12	14	15	17	19	22			
190	13	14	16	18	19	23			
195	13	14	16	18	20	23			
200	13	15	17	18	20	24			
205	14	15	17	19	21				
210	14	16	18	19	21				
215	14	16	18	20	22				
220	15	16	18	20	23				
225	15	17	19	21	24				
230	15	17	19	21	24				
235	16	18	19	22					
240	16	18	20	22					
245	16	18	20	23					
250	17	19	21	23					
260	17	19	22	24					
270	18	20	22						
280	19	21	23						
290	19	22	24						
300	20	23	24						
310	21	23							
320	21	24							
330	22								
340	23								
350	23								
360	24								

VI. MANAGEMENT OF CREAMERIES AND CHEESE FACTORIES.

PAYMENT OF MILK AT CREAMERIES AND CHEESE FACTORIES.

Numerous systematic and extensive experiments by various scientists have proved that the value of milk for both butter and cheese production stands in direct proportion to its fat content. Patrons of separator cheese and butter factories should therefore receive payment for the milk delivered by them according to the percentage of fat in the milk, i.e., according to the quantity of fat delivered in their milk. The same applies to gathered-cream factories as well.

The tables given on pp. 271–72 will aid in the calculation of the value of milks of different richness, according to prices agreed upon. In paying for the milk delivered by patrons, four, or, essentially, three, different methods are followed at different factories, all of which are just to all parties concerned. The methods and the directions for using the tables in each case are given below. The tables and discussions entered upon are largely taken from Vermont Experiment Station Bulletin No. 16.

METHODS OF PAYMENT FOR MILK AT CHEESE AND BUTTER FACTORIES.

1. *A certain price is to be paid per one hundred lbs. of milk containing a definite per cent of fat* (e.g., $1.00 per 100 lbs. of four per cent milk). By referring to the second half of the table on p. 271 we find $1.00 opposite 4.00 per cent of fat; the figures in the same column as $1.00 then give the value of 100 lbs. of milk containing percentages of fat ranging from 3.00 to 5.00; e.g., 100 lbs. of 3 per cent milk is worth 75 cents, of 4.5 per cent milk $1.13, of 5.40 per cent milk $1.35, etc.

2. *A certain price is to be paid per pound of fat delivered.* If 21 cents is the price agreed upon we multiply .21 by three, and the product, .63, gives the amount in dollars to be paid per 100 lbs. of three per cent milk. The column in which the figure .63 occurs opposite 3.0 per ct. is then to be used in the calculations as long as the price is paid, and 3.5 per cent milk will be paid with 73 cents per 100 lbs., 5.3 per ct. milk $1.10 per 100 lbs., etc.

Example: Patron A delivers 840 lbs. of milk during one week, containing, according to the test made, 4.3 per cent fat. If the price agreed upon per pound of fat was as before stated, he is to receive 90 cents per 100 lbs. of milk, or $7.56 in all.

Patron B, sending 625 lbs. of milk testing 3.45 per cent, will receive $6.25 \times .72 = \$4.50$, etc. In the table only tenths of per cents are given; 3.45 being half-way between 3.40 and 3.50, for which percentages 71 and 73 cents are to be paid respectively, we multiply by the mean of the two values, or .72. If a test differs less than five-hundredths from any percentages given in the table, the nearest figure is chosen.

3. *Patrons are to be paid what is received for the butter, less a certain amount for cost of making and marketing.* Multiply each man's milk by the per cent of fat it contains, and the sum of the several products will be the total amount of fat contained in the day's milk. Divide the pounds of butter made from the milk by the pounds of fat it contained, to

find how much butter each pound of fat makes. Multiplying the amount received per pound of butter, less the cost of making, etc., by this last result will give the amount to be paid for each pound of fat delivered.

Example: Suppose the patrons furnish milk containing in all 400 lbs. of fat, which made 460 lbs. of butter, selling for 27 cents per pound. The expense of making the butter is found to be, e.g., 4 cents per pound. $27-4 = 23$ cents; 460 divided by 400 equals 1.15; 23 multiplied by 1.15 equals 26.45, which is the amount, in cents, to be paid per pound of fat delivered; $26.45 \times 3 = 79.35$, or nearest 79 cents, is then the money to be paid for 100 lbs. of 3 per cent milk, and (see table) 90 cents for 100 lbs. of 3.40 per cent milk, $1.24 for 100 lbs. of 4.7 per cent milk, etc.

4. *A certain price is to be paid per* 100 *lbs. of milk of average quality.* Find the total fat contained in the milk as before; divide this amount by the total weight of milk delivered, and the result will be the average per cent of fat in the milk. Starting from this per cent at the left of the table, go to the right until the price per 100 lbs. agreed upon is reached; the perpendicular column in which this figure is found is the one to be used. *Example:* Suppose milk of average quality is to be paid $1.00 per hundred pounds, and the farmers furnish 8500 lbs. of milk, containing in all 440 lbs. of fat; 440 divided by 85.00 then equals 5.18, the number nearest to which in the table is 5.20 per cent. To the right of 5.20 per cent $1.00 is found in the column headed .58, which column would be the one to use.

PRICE OF MILK OF DIFFERENT RICHNESS PER 100 POUNDS.

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.								
3.00	1.00	.97	.94	.91	.88	.86	.83	.81	.79	.77
3.10	1.03	1.00	.97	.94	.91	.89	.86	.84	.82	.79
3.20	1.07	1.03	1.00	.97	.94	.91	.89	.86	.85	.82
3.30	1.10	1.07	1.03	1.00	.97	.94	.92	.89	.87	.84
3.40	1.13	1.10	1.06	1.03	1.00	.97	.94	.92	.90	.87
3.50	1.17	1.13	1.09	1.06	1.03	1.00	.97	.95	.93	.89
3.60	1.20	1.16	1.12	1.09	1.06	1.03	1.00	.97	.95	.92
3.70	1.23	1.19	1.16	1.12	1.09	1.06	1.03	1.00	.98	.94
3.80	1.27	1.23	1.19	1.15	1.12	1.09	1.06	1.03	1.00	.97
3.90	1.30	1.26	1.22	1.18	1.15	1.11	1.08	1.06	1.03	1.00
4.00	1.33	1.29	1.25	1.21	1.18	1.14	1.11	1.08	1.06	1.02
4.10	1.37	1.32	1.28	1.24	1.21	1.17	1.14	1.11	1.08	1.05
4.20	1.40	1.35	1.31	1.27	1.24	1.20	1.17	1.14	1.11	1.07
4.30	1.43	1.39	1.34	1.30	1.26	1.23	1.19	1.17	1.14	1.10
4.40	1.47	1.42	1.38	1.33	1.29	1.26	1.22	1.19	1.16	1.12
4.50	1.50	1.45	1.41	1.36	1.32	1.29	1.25	1.22	1.19	1.15
4.60	1.53	1.48	1.44	1.39	1.35	1.31	1.28	1.25	1.21	1.17
4.70	1.57	1.52	1.47	1.42	1.38	1.34	1.31	1.28	1.24	1.20
4.80	1.60	1.55	1.50	1.45	1.41	1.37	1.33	1.30	1.27	1.23
4.90	1.63	1.58	1.53	1.48	1.44	1.40	1.36	1.33	1.29	1.25
5.00	1.67	1.61	1.56	1.52	1.47	1.43	1.39	1.36	1.32	1.28
5.10	1.70	1.65	1.59	1.55	1.50	1.46	1.42	1.39	1.35	1.30
5.20	1.73	1.68	1.63	1.58	1.53	1.49	1.44	1.41	1.37	1.33
5.30	1.77	1.71	1.66	1.61	1.56	1.51	1.47	1.44	1.40	1.35
5.40	1.80	1.74	1.69	1.64	1.59	1.54	1.50	1.47	1.42	1.38
5.50	1.83	1.77	1.72	1.67	1.62	1.57	1.53	1.50	1.45	1.41
5.60	1.87	1.81	1.75	1.70	1.65	1.60	1.56	1.52	1.48	1.44
5.70	1.90	1.84	1.78	1.73	1.68	1.63	1.58	1.55	1.50	1.46
5.80	1.93	1.87	1.81	1.76	1.71	1.66	1.61	1.57	1.53	1.49
5.90	1.97	1.90	1.84	1.79	1.74	1.69	1.64	1.60	1.56	1.51
6.00	2.00	1.94	1.88	1.82	1.76	1.71	1.67	1.62	1.58	1.54

3.00	.75	.73	.71	.70	.68	.67	.65	.64	.63	.61
3.10	.78	.75	.73	.72	.70	.69	.67	.66	.65	.63
3.20	.80	.78	.76	.75	.73	.71	.69	.68	.67	.65
3.30	.83	.80	.78	.77	.75	.74	.72	.70	.69	.67
3.40	.85	.83	.81	.79	.77	.76	.74	.73	.71	.69
3.50	.88	.85	.83	.82	.79	.78	.76	.75	.73	.71
3.60	.90	.88	.85	.84	.82	.80	.78	.77	.75	.73
3.70	.93	.90	.88	.86	.84	.83	.80	.79	.77	.75
3.80	.95	.93	.90	.89	.86	.85	.82	.81	.80	.77
3.90	.98	.95	.92	.91	.88	.87	.85	.83	.82	.79
4.00	1.00	.97	.95	.93	.91	.89	.87	.85	.84	.81
4.10	1.03	1.00	.97	.96	.93	.91	.89	.87	.86	.83
4 20	1.05	1.02	1.00	.98	.95	.94	.91	.90	.88	.85
4.30	1.08	1.05	1.02	1.00	.98	.96	.93	.92	.90	.88
4.40	1.10	1.07	1.05	1.02	1.00	.98	.95	.94	.92	.90

PRICE OF MILK PER 100 POUNDS.—*Continued.*

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.									
4.50	1.13	1.10	1.07	1.05	1.02	1.00	.97	.96	.94	.92
4.60	1.15	1.12	1.10	1.07	1.05	1.02	1.00	.98	.96	.94
4.70	1.18	1.15	1.12	1.09	1.07	1.04	1.02	1.00	.98	.96
4.80	1.20	1.17	1.14	1.12	1.09	1.07	1.07	1.02	1.00	.98
4.90	1.23	1.20	1.17	1.14	1.11	1.09	1.07	1.04	1.02	1.00
5.00	1.25	1.22	1.19	1.16	1.14	1.11	1.09	1.06	1.04	1.02
5.10	1.28	1.24	1.21	1.19	1.16	1.13	1.11	1.09	1.06	1.04
5.20	1.30	1.27	1.24	1.21	1.18	1.16	1.13	1.11	1.08	1.06
5.30	1.33	1.29	1.26	1.23	1.20	1.18	1.15	1.13	1.10	1.08
5.40	1.35	1.32	1.29	1.26	1.23	1.20	1.17	1.15	1.12	1.10
5.50	1.38	1.34	1.31	1.28	1.25	1.22	1.20	1.17	1.14	1.12
5.60	1.40	1.37	1.34	1.30	1.27	1.24	1.22	1.19	1.17	1.14
5.70	1.43	1.39	1.36	1.33	1.30	1.27	1.24	1.21	1.19	1.16
5.80	1.45	1.41	1.39	1.35	1.32	1.29	1.26	1.23	1.21	1.18
5.90	1.48	1.44	1.41	1.38	1.34	1.31	1.28	1.26	1.23	1.20
6.00	1.50	1.46	1.43	1.40	1.36	1.33	1.30	1.28	1.25	1.22

3.00	.60	.59	.58	.57	.56	.55	.54	.53	.52	.51	.50
3.10	.62	.61	.60	.59	.58	.57	.56	.55	.54	.53	.52
3.20	.64	.63	.62	.61	.60	.59	.58	.57	.55	.54	.53
3.30	.66	.65	.64	.63	.62	.60	.59	.58	.57	.56	.55
3.40	.68	.67	.66	.65	.63	.62	.61	.60	.59	.58	.57
3.50	.70	.69	.68	.66	.65	.64	.63	.62	.61	.59	.58
3.60	.72	.71	.70	.68	.67	.66	.65	.64	.62	.61	.60
3.70	.74	.73	.71	.70	.69	.68	.67	.65	.64	.63	.62
3.80	.76	.75	.73	.72	.71	.70	.68	.67	.66	.65	.63
3.90	.78	.77	.75	.74	.73	.71	.70	.69	.67	.66	.65
4.00	.80	.79	.77	.76	.75	.73	.72	.71	.69	.68	.67
4.10	.82	.81	.79	.78	.76	.75	.74	.72	.71	.70	.68
4.20	.84	.83	.81	.80	.78	.77	.75	.74	.73	.71	.70
4.30	.86	.84	.83	.82	.80	.79	.77	.76	.74	.73	.72
4.40	.88	.86	.85	.83	.82	.80	.79	.78	.76	.75	.73
4.50	.90	.88	.87	.85	.84	.82	.81	.79	.79	.76	.75
4.60	.92	.90	.89	.87	.86	.84	.83	.81	.80	.78	.77
4.70	.94	.92	.91	.89	.88	.86	.84	.83	.81	.80	.78
4.80	.96	.94	.93	.91	.90	.88	.86	.85	.83	.81	.80
4.90	.98	.96	.94	.93	.91	.90	.88	.86	.85	.83	.82
5.00	1.00	.98	.96	.95	.93	.91	.90	.88	.86	.85	.83
5.10	1.02	1.00	.98	.96	.95	.93	.92	.90	.88	.86	.85
5.20	1.04	1.02	1.00	.98	.97	.95	.93	.92	.90	.88	.87
5.30	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92	.90	.88
5.40	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92	.90
5.50	1.10	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92
5.60	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95	.93
5.70	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95
5.80	1.16	1.14	1.12	1.09	1.07	1.05	1.04	1.02	1.00	.98	.97
5.90	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.04	1.02	1.00	.98
6.00	1.20	1.18	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.02	1.00

DIRECTIONS FOR MAKING DIVIDENDS IN CREAMERIES AND CHEESE FACTORIES

According to the Per Cent of Fat in Milk Delivered.

(S. M. Babcock, in "Hoard's Dairyman.")

Find the amount of fat contained in the milk of each patron for any period desired, by multiplying the pounds of milk expressed in hundreds by the per cent of fat found by the test. Add together the amount of fat from all the patrons, thus obtaining the total pounds of fat delivered at the factory. Deduct the expenses of manufacture, etc., from the money received from sales, and divide the remainder by the total fat. This gives the price to be paid for each pound of fat. Multiply the pounds of fat delivered by each patron by the price; the product will be the amount which he is to receive.

If it is desired to know the number of pounds of butter made from each patron's milk, divide the total yield of butter by the total fat delivered; the quotient will be the amount of butter made from one pound of fat. The fat delivered by each patron multiplied by this figure will give the pounds of butter to be credited to each patron.

The accompanying table gives the butter yield from 100 lbs. of milk, when the pounds of butter from one pound of fat range from 1.10 to 1.20, and for milks containing from 3 to 6 per cent of fat. To use the table find in the upper horizontal line the number corresponding most nearly to the number of pounds of butter from one pound of fat. The vertical column in which this falls gives the pounds of butter from 100 pounds of milk containing the per cents of fat given in the outside columns.

Example: A creamery receives during one month 250,000 lbs. of milk, which contained 9531 lbs. of fat; the yield of butter for the same period was 10,983 lbs., which sold for 29 cents per pound, bringing $3185.07. The expense for making, etc., was four cents per pound, amounting to $439.32, leaving $2745.75 to be divided among the patrons. Dividing this sum by 9531, the total number of pounds of fat gives 28.8 cents per pound for the fat. This multiplied by the number of pounds of fat in each patron's milk gives the amount which he should be paid.

The number of pounds of butter, 10,983, divided by 9531, the number of pounds of fat, gives 1.152 pounds of butter from each pound of fat. The column headed 1.15 in the table is nearest to this ratio, and will therefore give the butter obtained from 100 lbs. of milk containing different per cents of fat.

If a patron delivered 9420 lbs. of milk containing 3.2 per cent of fat during the period considered, his milk would have contained 301.44 lbs. of fat, which at 28.8 cents per pound would have amounted to $86.81. It would have made 301.44 × 1.152 = 347.26 lbs. of butter. In the column headed 1.15 in the table, opposite 3.2 per cent of fat, we find 3.68, which is the number of pounds of fat from 100 lbs. of this patron's milk. The error from the use of the table in this way will never amount to more than ½ ounce per 100 lbs. of milk.

Yield of Butter from One Hundred Lbs. of Milk, in Lbs.

Per cent Fat.	Lbs. of Butter per Pound of Fat.											Per cent Fat.
	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	
3.0	3.30	3.33	3.36	3.39	3.42	3.45	3.48	3.51	3.54	3.57	3.60	3.0
3.1	3.41	3.441	3.472	3.503	3.534	3.565	3.596	3.627	3.658	3.689	3.72	3.1
3.2	3.52	3.552	3.584	3.616	3.648	3.680	3.712	3.744	3.776	3.808	3.84	3.2
3.3	3.63	3.663	3.696	3.729	3.762	3.795	3.828	3.861	3.894	3.927	3.96	3.3
3.4	3.74	3.774	3.808	3.842	3.876	3.910	3.944	3.978	4.012	4.046	4.08	3.4
3.5	3.85	3.885	3.920	3.955	3.990	4.025	4.060	4.095	4.130	4.165	4.20	3.5
3.6	3.96	3.996	4.032	4.068	4.104	4.140	4.176	4.212	4.248	4.284	4.32	3.6
3.7	4.07	4.107	4.144	4.181	4.218	4.255	4.292	4.329	4.366	4.403	4.44	3.7
3.8	4.18	4.218	4.256	4.294	4.332	4.370	4.408	4.446	4.484	4.522	4.56	3.8
3.9	4.29	4.329	4.368	4.407	4.446	4.485	4.524	4.563	4.602	4.641	4.68	3.9
4.0	4.40	4.440	4.480	4.520	4.560	4.600	4.640	4.680	4.720	4.760	4.80	4.0
4.1	4.51	4.551	4.592	4.633	4.674	4.715	4.756	4.797	4.838	4.870	4.92	4.1
4.2	4.62	4.662	4.704	4.746	4.788	4.830	4.872	4.914	4.956	4.998	5.04	4.2
4.3	4.73	4.773	4.816	4.859	4.902	4.945	4.988	5.031	5.074	5.117	5.16	4.3
4.4	4.84	4.884	4.928	4.972	5.016	5.060	5.104	5.148	5.192	5.236	5.28	4.4
4.5	4.95	4.995	5.040	5.085	5.130	5.175	5.220	5.265	5.310	5.355	5.40	4.5
4.6	5.06	5.106	5.152	5.198	5.244	5.290	5.336	5.382	5.428	5.474	5.52	4.6
4.7	5.17	5.217	5.264	5.311	5.358	5.405	5.452	5.499	5.546	5.593	5.64	4.7
4.8	5.28	5.328	5.376	5.424	5.472	5.520	5.568	5.616	5.664	5.712	5.76	4.8
4.9	5.39	5.439	5.488	5.537	5.586	5.635	5.684	5.733	5.782	5.831	5.88	4.9
5.0	5.50	5.550	5.600	5.650	5.700	5.750	5.800	5.850	5.900	5.950	6.00	5.0
5.1	5.61	5.661	5.712	5.763	5.814	5.865	5.916	5.967	6.018	6.069	6.12	5.1
5.2	5.72	5.772	6.824	5.876	5.928	5.980	6.032	6.084	6.136	6.188	6.24	5.2
5.3	5.83	5.883	5.936	5.986	6.042	6.095	6.148	6.201	6.254	6.307	6.36	5.3
5.4	5.94	5.994	6.048	6.102	6.156	6.210	6.264	6.318	6.372	6.426	6.48	5.4
5.5	6.05	6.105	6.160	6.215	6.270	6.325	6.380	6.435	6.490	6.545	6.60	5.5
5.6	6.16	6.216	6.272	6.328	6.384	6.440	6.496	6.552	6.608	6.664	6.72	5.6
5.7	6.27	6.327	6.384	6.441	6.498	7.555	6.612	6.669	6.726	6.783	6.84	5.7
5.8	6.38	6.438	6.496	6.554	6.612	6.670	6.728	6.786	6.844	6.902	6.96	5.8
5.9	6.49	6.549	6.608	6.667	6.726	6.785	6.844	6.903	6.962	7.021	7.08	5.9
6.0	6.60	6.660	6.720	6.780	6.840	6.900	6.960	7.020	7.080	7.140	7.20	6.0

TABLE SHOWING AVERAGE PER CENT OF FAT IN MILK. (Partly after MARTINY.)

Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.
5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.	
14.50	11.60	8.70	**2.90**	16.50	13.20	9.90	**3.30**	18.50	14.80	11.10	**3.70**
55	64	73	91	55	24	93	31	55	84	13	71
60	68	76	92	60	28	96	32	60	88	16	72
65	72	79	93	65	32	99	33	65	92	19	73
70	76	82	94	70	36	10.02	34	70	96	22	74
14.75	11.80	8.85	**2.95**	16.75	13.40	10.05	**3.35**	18.75	15.00	11.25	**3.75**
80	84	88	96	80	44	08	36	80	04	28	76
85	88	91	97	85	48	11	37	85	08	31	77
90	92	94	98	90	52	14	38	90	12	34	78
95	96	97	99	95	56	17	39	95	16	37	79
15.00	12.00	9.00	**3.00**	17.00	13.60	10.20	**3.40**	19.00	15.20	11.40	**3.80**
05	04	03	01	05	64	23	41	05	24	43	81
10	08	06	02	10	68	26	42	10	28	46	82
15	12	09	03	15	72	29	43	15	32	49	83
20	16	12	04	20	76	32	44	20	36	52	84
15.25	12.20	9.15	**3.05**	17.25	13.80	10.35	**3.45**	19.25	15.40	11.55	**3.85**
30	24	18	06	30	84	38	46	30	44	58	86
35	28	21	07	35	88	41	47	35	48	61	87
40	32	24	08	40	92	44	48	40	52	64	88
45	36	27	09	45	96	47	49	45	56	67	89
15.50	12.40	9.30	**3.10**	17.50	14.00	10.50	**3.50**	19.50	15.60	11.70	**3.90**
55	44	33	11	55	04	53	51	55	64	73	91
60	48	36	12	60	08	56	52	60	68	76	92
65	52	39	13	65	12	59	53	65	72	79	93
70	56	42	14	70	16	62	54	70	76	82	94
15.75	12.60	9.45	**3.15**	17.75	14.20	10.65	**3.55**	19.75	15.80	11.85	**3.95**
80	64	48	16	80	24	68	56	80	84	88	96
85	68	51	17	85	28	71	57	85	88	91	97
90	72	54	18	90	32	74	58	90	92	94	98
95	76	57	19	95	36	77	59	95	96	97	99
16.00	12.80	9.60	**3.20**	18 00	14.40	10.80	**3.60**	20.00	16.00	12.00	**4.00**
05	84	63	21	05	44	83	61	05	04	03	01
10	88	66	22	10	48	86	62	10	08	06	02
15	92	69	23	15	52	89	63	15	12	09	03
20	96	72	24	20	56	92	64	20	16	12	04
16.25	13.00	9.75	**3.25**	18.25	14.60	10.95	**3.65**	20.25	16.20	12.15	**4.05**
30	04	78	26	30	64	98	66	30	24	18	06
35	08	81	27	35	68	11.01	67	35	28	21	07
40	12	84	28	40	72	04	68	40	32	24	08
45	16	87	29	45	76	07	69	45	36	27	09

TABLE SHOWING AVERAGE PER CENT OF FAT IN MILK.—(*Continued.*)

Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.
5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.	
20.50	16.40	12.30	**4.10**	22.50	18.00	13.50	**4.50**	24.50	19.60	14.70	**4.90**
55	44	33	11	55	04	53	51	55	64	73	91
60	48	36	12	60	08	56	52	60	68	76	92
65	52	39	13	65	12	59	53	65	72	79	93
70	56	42	14	70	16	62	54	70	76	82	94
20.75	16.60	12.45	**4 15**	22.75	18.20	13 65	**4.55**	24.75	19.80	14.85	**4.95**
80	64	48	16	80	24	68	56	80	84	88	96
85	68	51	17	85	28	71	57	85	88	91	97
90	72	54	18	90	32	74	58	90	92	94	98
95	76	57	19	95	36	77	59	95	96	97	99
21.00	16.80	12.60	**4.20**	23.00	18.40	13.80	**4.60**	25.00	20.00	15.00	**5.00**
05	84	63	21	05	44	83	61	05	04	03	01
10	88	66	22	10	48	86	62	10	08	06	02
15	92	69	23	15	52	89	63	15	12	09	03
20	96	72	24	20	56	92	64	20	16	12	04
21.25	17.00	12.75	**4.25**	23 25	18.60	13.95	**4.65**	25.25	20.20	15.15	**5.05**
30	04	78	26	30	64	98	66	30	24	18	06
35	08	81	27	35	68	14.01	67	35	28	21	07
40	12	84	28	40	72	04	68	40	32	24	08
45	16	87	29	45	76	07	69	45	36	27	09
21.50	17.20	12.90	**4.30**	23.50	18.80	14.10	**4.70**	25.50	20.40	15.30	**5.10**
55	24	93	31	55	84	13	71	55	44	33	11
60	28	96	32	60	88	16	72	60	48	36	12
65	32	99	33	65	92	19	73	65	52	39	13
70	36	13 02	34	70	96	22	74	70	56	42	14
21.75	17.40	13.05	**4.35**	23.75	19.00	14.25	**4.75**	25.75	20.60	15.45	**5.15**
80	44	08	36	80	04	28	76	80	64	48	16
85	48	11	37	85	08	31	77	85	68	51	17
90	52	14	38	90	12	34	78	90	72	54	18
95	56	17	39	95	16	37	79	95	76	57	19
22.00	17.60	13.20	**4.40**	24.00	19.20	14.40	**4.80**	26.00	20.80	15.60	**5.20**
05	64	23	41	05	24	43	81	05	84	63	21
10	68	26	42	10	28	46	82	10	88	66	22
15	72	29	43	15	32	49	83	15	92	69	23
20	76	32	44	20	36	52	84	20	96	72	24
22.25	17.80	13.35	**4.45**	24.25	19.40	14.55	**4.85**	26.25	21.00	15.75	**5.25**
30	84	38	46	30	44	58	86	30	04	78	26
35	88	41	47	35	48	61	87	35	08	81	27
40	92	44	48	40	52	64	88	40	12	84	28
45	96	47	49	45	56	67	89	45	16	87	29

SUGGESTIONS TO PATRONS OF CHEESE FACTORIES AND CREAMERIES.

(D. W. CURTIS, Sec'y Wisconsin Dairymen's Association.)

Care of Milk.

1. All milk for the cheese factory must be clean, pure, and wholesome, or the cheese will be bad. One hundred pounds of bad milk will injure 10,000 pounds of good milk.

2. The law is very strict against watering or skimming. A fine of $10.00 to $100.00 is imposed if convicted.

3. After a cow has dropped her calf, the milk should not be taken to the factory until the tenth milking.

4. Milk run through an aerator as soon as drawn from the cow, in open air, is better for cheese and butter making than when set in a tub of water and dipped. By any means at your command thoroughly air the milk until cooled.

5. Stagnant water, dead carcasses, or filth of any kind in the pasture or barn-yard produces tainted milk. For this reason set the can of night's milk in a clean place.

6. Milk with clean hands; never wet them with milk; it is positively filthy.

7. See that the cow's udder is brushed clean and free from fine dirt and dust before milking.

8. Never mix the night's and morning's milk. It will many times sour them both by pouring the warm milk into the cold.

9. Small cans (10 to 15 gallons) are much preferred to larger ones, as the milk is kept in a better condition.

10. Whey should be taken home in separate cans from that in which the milk is brought in.

11. If whey is taken home in the milk-cans, empty at once, wash with tepid water, then scald and turn them out to the sun.

12. Insist that the cheese-maker keep the whey-vat clean, by washing and scalding at least twice a week.

13. Insist that your factory shall take in milk by the Babcock test, paying each patron according to what he delivers.

14. Use a Babcock test yourself and know just what you produce; turn off the poor cows and fill their places with

good ones. Every patron should know for himself whether he is boarding unprofitable cows. There is no better way of knowing this than by the use of the Babcock test at the barn. The cost of the test is but little, but its instruction is very valuable.

15. It should always be remembered that pure milk can only be had through healthy cows, pure feed, pure water, pure air, and cleanly handling. Every patron is affected in the cash outcome by the way his brother patrons produce and handle their milk, hence the necessity of each adhering to sound rules based on sound dairy sense. There is not a first-class factory in the land where good prices are obtained for cheese but what the patrons practise thorough cleanliness in the care of milk. Remember, it is a matter of profit to each to do this.

Care of Cows.

Pay special attention to the comfort of your cows. Do not let them remain out in cold rain-storms ; it will reduce the flow of milk. Feed liberally. The cow must at all times have all the good feed she can eat and digest. Be sure and provide some soiling-crop against the July and August drought; if the cow shrinks then you will lose money in the fall, when butter and cheese are high. Oats and peas, sweet corn or field corn, drilled 3½ feet apart, are a good soiling-crop.

A silo is a great help in the economical production of cow feed. Thousands of successful dairymen have proved this. It is no longer an experiment.

Dairy farming at high profit calls for close study concerning the cow, concerning her feed, and how to produce it at the best and cheapest. Every dairy neighborhood will show men who make nearly double the profit from the business that others do. We believe that it will pay every man to be intelligent and as well posted as he can be on these important questions. We must bring up the grade of our reputation by making better butter and cheese. This will bring on a larger and better paying demand. To cheat the

consumer with poor goods will, in the end, destroy the business. Better dairymen, better milk, better products, better reputation in the world's markets, will surely bring better profits, and is the only true road to DAIRY SUCCESS.

BY-LAWS AND RULES FOR CO-OPERATIVE CREAMERY ASSOCIATIONS.

I. This association shall be known as the — — Co-operative Creamery Association.

II. The purpose of the association shall be to locate, establish and carry on the manufacture and sale of milk products, in such a manner as will conduce to the greatest convenience and profit of the producers over the greatest amount of territory in the town of — — and vicinity. Also to purchase, use, and hold real and personal estate necessary for the transaction of the business of the association.

III. The capital stock of the association shall be — — dollars, divided into — — shares of ten dollars each.

IV. This association shall be co-operative. Cream and milk may be purchased or accepted from any person not a stockholder on the same terms and conditions as may be prescribed for stockholders.

V. Any person directly engaged in agricultural pursuits may become a member of this association by taking one or more shares of the stock of the association.

VI. 1. The regular meetings of the association shall be held semi-annually, viz., on the first Mondays in — — and — — — in each year, at such time and place as the board of directors may determine; and notice of such meeting shall be given by the clerk to each member by mail seven days at least previous to the date of said meeting. 2. Special meetings may be called either by the president, with the advice and consent of a majority of the directors, or upon written request of one third of the stockholders of the association, upon seven days' notice as above. 3. Meetings of the board of directors may be called by the president or by any two directors.

VII. 1. The officers of the association shall consist of a president, clerk, treasurer, five directors, and two auditors. 2. The president shall be chosen annually by the board of

directors, by written ballot, at the regular meeting in October. 3. The clerk, treasurer, board of directors, and auditors shall be chosen by the stockholders annually, by written ballot, at the regular meeting in October, and all officers shall hold office till others are chosen and qualified in their stead. Vacancies in the above-named offices may be filled at any meeting of the stockholders ; in the meantime by the board of directors. In case of the absence of the clerk a temporary clerk may be chosen and qualified in his stead.

VIII. At any regularly called meeting of the association, nine of the members thereof, and at any meeting of the board of directors, three members thereof, shall constitute a quorum for the transaction of business. A less number may adjourn from time to time.

IX. It shall be the duty of the president, who shall be a director, to preside at all meetings of the association and of the board of directors, preserve order therein, put all questions, announce all decisions, and, in case of an equal division, to give the casting vote. He shall receive and safely preserve all bonds required of the officers of the association and sign all certificates or documents issued by the association or board of directors. In the absence of the president, it shall be the duty of one of the board of directors, in order of their seniority, to preside at any meeting.

X. It shall be the duty of the clerk to attend all meetings of the association and of the board of directors, and to keep a correct record of the same, which record shall be open for the inspection of any member. He shall give notice of all meetings and of all appointments on committees, to each member thereof, and to each officer chosen, of his election; and shall serve all such other notices as appertain to his office or as may be directed from time to time by the association or board of directors. He shall attest all certificates or documents issued signed by the president, shall file all bills and reports and such other documents as may be ordered to be filed, and shall carry on all such correspondence as may be directed ; shall act as secretary of all committees when called upon; shall keep a correct

financial account between the association and its members, and shall have charge of all property not otherwise disposed of. He shall give such bonds for the faithful performance of his duty, and receive such compensation for his services, as the board of directors may determine.

XI. It shall be the duty of the treasurer to receive all money belonging to the association, giving his receipt therefor. He shall draw all money for the payment of claims against the association under the direction of the board of directors. He shall make a report to the board of directors at such times as they may require. He shall perform all duties required of him by the laws of the commonwealth and shall give such bonds for the faithful performance of his duty as the board of directors may require.

XII. It shall be the duty of the board of directors to attend to the general affairs of the association, invest the funds of the same, appoint such other agents and officers as in their judgment the interests of the association require, and fix all compensations. They shall keep or cause to be kept a correct account of all cream or milk furnished by the stockholders or patrons, and a correct account of all sales. They shall prescribe the rules and regulations governing the collection and delivery of the cream and milk; may cause the quality of the same to be tested as often as may be deemed expedient; may authorize the premises of any stockholder or patron to be inspected, and may reject and refuse to collect or receive any cream or milk that is unsatisfactory or not furnished in compliance with the prescribed regulations. They shall establish prices and have full power over the business of the association, and shall in all cases pursue such measures as in their judgment will tend to the best interests of the association. They shall make a full report of their doings, and a full statement of the business at each regular meeting, or whenever called upon to do so by vote of the stockholders.

XIII. The duties of the auditors shall be to audit all accounts of the association, making a report to the board of directors at the time of the regular meetings, and at such other times as they may require.

XIV. The net profits of the business of the association, after such deductions have been made as the laws of the commonwealth require, shall be divided *pro rata* among the stockholders, according to the number of shares held by each. [*Note.*—It is understood that the profits shall not exceed 6 per cent on capital, all receipts in excess of this sum and necessary reserves being declared in payment to patrons for cream or milk furnished.]

XV. 1. Any person doing business for the association or incurring expense therefor shall receive a just remuneration for such services or expense. 2. All documents issued by the association shall bear the seal thereof, said seal to be in charge of the clerk. 3. The directors shall procure a corporate seal. 4. No member of the association can transfer his stock to any person not directly engaged in agricultural pursuits. 5. In case shares are transferred by one person to another, the certificate thereof must be surrendered to the treasurer, and the board of directors shall cause another certificate to be issued to the person to whom the transfer is made.

XVI. These by-laws shall not be altered or amended unless such alteration or amendment be proposed in writing one meeting previous to action being taken ; provided also that two thirds of the members vote in the affirmative.

BY-LAWS AND RULES FOR CO-OPERATIVE CHEESE FACTORIES.

ARTICLE 1. This association shall be known as the — — — Cheese Factory Association.

ART. 2. There shall be two meetings held yearly at the factory—one in the spring and one in the fall or winter, to be called by the president.

ART. 3. At the first meeting in each year there shall be chosen by the patrons a president and a treasurer and salesman.

ART. 4. The salesman and treasurer shall sell all the cheese, and as soon as he shall have sold and collected for one month's make of cheese, he shall, after paying the proprietor for mak-

ing and deducting the other expenses, divide the proceeds *pro rata*, according to the amount of butter-fat delivered by each patron, as determined by the Babcock test.

ART. 5. It shall also be the duty of the treasurer and salesman to keep the books of the association, and make final dividend yearly to all the patrons whenever all the cheese is sold and paid for. He shall also keep a milk book, showing the number and amount of cheese made each month, to be taken from the factory's books. Said treasurer's milk and cheese books shall be subject to the inspection of the patrons and the president.

ART. 6. The manager shall keep an accurate account with each patron of the number of pounds of milk delivered each day and make and record daily (every week or month) tests of same to show its fat content; also an account of the number and amount of cheese made, which accounts shall be subject to the inspection of the officers and patrons.

ART. 7. The president shall be authorized to preside over the entire transactions of patrons or officers, and constitute a committee to investigate all matters pertaining to said factory, and if any contingency should arise, he shall be authorized to bring suit in law against any delinquent.

ART. 8. The manager (cheese-maker) shall be authorized to criticise all milk offered, and he shall reject the same if in his judgment said milk is unfit to run into cheese; also to determine the fat content of any milk, and if found to be below the legal standard of the State, shall report the same to the president, whose duty it shall be to send out a committee of three to the premises of said delinquent, witnessing the transit of the milk on the ensuing day from the cow to the factory, which shall again be tested as on the previous day, and if found to vary, the party in question shall be adjudged guilty of having diluted or adulterated the same, as shall appear, and shall forfeit and pay to the association as liquidated damages the sum of twenty-five dollars for each and every day such dilution shall occur.

ART. 9. The president shall also have power to call special meetings of the patrons at any time he may deem it necessary. and he shall be required to call a meeting of the patrons when-

ever a request is presented to him signed by ten patrons. Whenever a meeting is to be called, the president shall give patrons at least two days' notice.

ART. 10. The action of the treasurer and salesman in regard to selling or holding cheese shall be governed by a vote of a majority of the patrons. If no vote is taken, he is to exercise his best judgment in the matter.

ART. 11. In voting at any annual or special meeting of this association the patrons shall be allowed one vote for every cow the milk of which is brought to the factory. [This may be altered to one vote on each share of the capital stock or one vote to each shareholder.]

ART. 12. The treasurer and salesman shall attend all meetings of the association whenever possible, and shall take minutes of the proceedings, and place the same on file in his office, and in other respects act as secretary. In case he should be absent, a temporary secretary may be chosen. In case the president is absent at any meeting, a temporary president may be chosen for a presiding officer.

RULES FOR PATRONS AND INSTRUCTIONS TO CREAM OR MILK GATHERERS.

These rules may be made to apply to either whole-milk or gathered-cream creameries.

Feeding.—We insist upon only such food being fed to cows as will produce the largest and best quality of milk or cream. Turnips, onions, cabbage, or anything likely to injure the quality of milk, cream, or butter is prohibited.

Milking.—Cows must be carefully cleaned before milking, to avoid odors that taint the milk. The milk must be strained through two strainers—one of them cloth—before going into the cans. Thorough cleanliness must be observed in everything.

Creamers and Cans.—Creamers must be kept in a place free from odors, and cleanliness maintained in their vicinity Tanks and cans must be kept sweet and clean, and the water free and clear. Cans must be *washed, then scalded every time* they are used. The water in the creamers should not go below 45 degrees in summer and 40 degrees in winter.

Setting Milk.—All cans must be filled full of fresh milk, so far as possible, and immediately placed in the tank. After cans are set in water they must not be disturbed. Patrons are not allowed to draw off the milk except on Sundays, or with permission from the trustees.

Mixing Milk.—Cans must not be partly filled at one milking and after standing long enough for the cream to begin to separate be filled with milk from another milking, or with anything whatever. After a can has once been set it must not in any way be disturbed or meddled with, nor the milk drawn off by the patrons, except on Sunday.

Night's Milk.—When milk is delivered but once each day, the cans containing the night's milk must be set in cold water immediately after milking and the milk thoroughly stirred by using a dipper and pouring until the milk is thoroughly cooled. A better plan is to use a cooler to thoroughly cool and aerate the milk before it is put in the cans. The night's milk must be left setting in cold water until it is hauled to the creamery.

Cream and Milk Gatherers.—Cream and milk gatherers are forbidden to take any cream or milk which is dirty, or for any reason, in their judgment, is not of satisfactory quality or condition, or which has been in any way so treated as to indicate that an attempt has been made to interfere with the proper and natural separation of the cream, or of its being correctly counted on the gauge, or in violation of these rules.

Any patron found neglecting or violating any of these rules must at once be reported to some one of the board of trustees or directors, and his cream or milk must not again be taken till he has satisfied the trustees that his neglect was, for good reasons, excusable ; and if any patron shall more than once be so reported it shall be deemed a sufficient reason for refusal to again receive his cream at all.

Cream or milk gatherers are especially directed to take all possible pains to discover all violations or neglect of any of these rules, and strictly enforce them in every case.

These rules and instructions are found by experience and observation to be necessary for the protection of the association and the best good of all its members. Copies thereof will be securely posted conveniently near each tank where milk-cans are set, so that ignorance can be no excuse for neglect.

Patrons are requested to notify the board of trustees or directors if any cream or milk gatherer is in any way delinquent or careless in his observance of these instructions.

Patrons who are not disposed to be governed by these rules are requested to so advise the trustees or directors, and the treasurer will make prompt settlement with any who wish to withdraw.

By order of the trustees or directors.

.................................., President.

.................................., Treas.

PART III. GENERAL TOPICS.

I. CONSTITUTIONS OF AGRICULTURAL ASSOCIATIONS.

CONSTITUTION AND BY-LAWS OF AGRICULTURAL CLUBS.

Together With Rules of Order, and Order of Business.

(McKerrow.)

Constitution.

Preamble.—We, the undersigned, interested in agriculture and horticulture, and desirous to secure the benefits to be derived from organization, for the purpose of practical discussion and the promotion of the common interests of our pursuits, do subscribe the following Constitution:

Article I. *Name.*—This association shall be styled and known as the —— Agricultural Club.

Article II. *Objects.*—The objects of this club are to advance the knowledge and promote the general interests of agriculture and horticulture in this community.

Article III. *Officers.* — The officers shall consist of a president, vice-president, recording secretary, corresponding secretary, treasurer, and librarian.

Article IV. *Duties of Officers.*—Section 1. It shall be the duty of the president to preside at all meetings of the club; to enforce a due observance of the Constitution, By-laws, and Rules of Order; to assign topics of discussion at the suggestion of members. He shall neither make nor second any motion, but shall have the privilege of taking part in debate; and while he has the floor the meeting for the time being shall be in charge of the vice-president; but the president shall have no vote unless the club shall be equally divided.

Section 2. It shall be the duty of the vice-president to preside at all times when the president is absent, and while he shall have temporarily vacated the chair.

Section 3. The recording secretary shall keep a record of the proceedings of the club; also the name of each member, and shall on the regular last meeting of each year prepare and read the names of all members; and he shall have charge of the archives of the club.

Section 4. The corresponding secretary shall conduct the correspondence of the club and act as recording secretary in the absence of that officer. He shall also render such assistance to the recording secretary as that officer may require in the performance of his duties.

Section 5. The treasurer shall keep all money belonging to the club, and disburse the same under the direction of the club, according to its laws. He shall collect all fees and dues of members, and shall at some time during the month of December of each year notify such as are in arrears and request their dues. He shall keep a correct account of all moneys received and expended.

Section 6. The librarian shall have charge of the library and its appurtenances, regulating the use of the same by the members, according to the rules and regulations prescribed. He shall make a written report of the condition of the library at the annual meeting, and at such other times as the club may direct. He shall, within one week, deliver to his successor in office the library and its appurtenances, and all books, papers, and documents in his possession belonging to the club.

ARTICLE V. *Elections.*—All elections for officers shall be by ballot, and shall be held at the first regular meeting in January of each year; and their terms shall commence immediately after their election, to continue for one year, or until others are elected to fill their places. In the case of vacancy occurring in any office the club shall go immediately into an election to fill the same. A majority of all the votes cast shall be necessary to a choice.

ARTICLE VI. *Membership.*—Section 1. Any person interested in agriculture or horticulture, and of good moral standing, may become a member of this club by signing this Constitution, agreeing to support all laws and regulations made in pursuance thereof, and paying fifty cents annually into the treasury.

Section 2. Honorary membership may be conferred in

consideration of eminent character and services in honor of agriculture or horticulture and shall be conferred without fee or dues. The recipient shall not be entitled to hold office, but may take part in all discussions and vote on all questions.

ARTICLE VII. *Amendments.*—No alteration, amendment, or addition can be made to this Constitution, neither can any part of it be repealed, without a vote of two thirds of the members present. Any proposed alteration, amendment, addition, or repeal must be submitted in writing, filed with the recording secretary, and read at two regular meetings next preceding that on which the vote is taken.

By-laws.

ARTICLE I. This club shall assemble weekly (or twice a month) on —— evenings from November 1st to April 1st, and at such intervals thereafter as may be agreed upon by the club, or appointed by the president. The time and place of meeting may be altered at any regular meeting of the club by a vote of two thirds of all of the members present.

ARTICLE II. Section 1. Seven members shall constitute a quorum for the transaction of business of the club. A less number may meet, maintain a discussion on any topic, and adjourn to any given time.

Section 2. Persons present, not members of the club, may be invited to take part in all discussions of agricultural topics; but they shall take no part in the business of the club.

ARTICLE III. Section 1. If the funds of the club should at any time be exhausted, or inadequate to meet the demands contemplated by the Constitution, there shall be an equal assessment upon each member to make up the deficiency.

Section 2. No appropriation of money from the funds of the club shall be lawful, except in furtherance of the objects contemplated by the Constitution, as stated in article 2, or as especially provided by these By-laws.

ARTICLE IV. Section 1. There shall be a library estab-

lished for the use of the club in furtherance of the objects contemplated in article 2 of the Constitution.

Section 2. The library shall be open to the free use of the members of the club, who shall not be more than three months indebted to the treasury, subject to the prescribed rules and regulations.

Section 3. The library shall be maintained by the surplus fund, after defraying the expenses of the club, and by the voluntary contributions and donations of the members, to be duly accredited to each contributor and donor.

Section 4. The library shall be in charge of the librarian, as provided in article 4, section 6, of the Constitution. There shall be a standing library committee of three members appointed at each annual meeting, of whom the librarian shall be one, and *ex-officio* chairman, which shall have charge of the purchase and collection of books, papers, and pamphlets for the library, and perform such other duties as may be ordained.

Section 5. *Rules.*—Rule 1. No member shall have from the library more than one (two) book(s) at a time.

Rule 2. No volume shall be retained longer than two weeks, under penalty of a fine of ten cents for the first week of detention, and five cents for every week thereafter.

Rule 3. There shall be assessed for injuries as follows: 1st. For an injury beyond ordinary wear, an amount proportionate to the injury, ascertained by the librarian. 2d. For the loss of the volume, the cost of the book; and if one of a set, an amount sufficient to replace it, or purchase a new volume.

Rule 4. No person having incurred a fine shall be permitted to take books from the library until the fine is paid.

Article V. A vote of two thirds of all the members present shall be required to pass any appropriation of money by the club, other than for its necessary contingent expenses.

Article VI. Section 1. Any member who shall suffer his account with the treasurer to go unsettled for more than one year shall cease to be considered as belonging to the club, and his name shall be stricken from the roll accordingly.

Section 2. Any member who shall be guilty of any gross violation of the rules of order, or of profane or indecent language or conduct, at any of the meetings of the club shall be fined, reprimanded, or expelled, as the club may, by a two thirds vote, decide.

Section 3. Any member who shall become guilty of any heinous offence or disgraceful practice, such as to render him an unfit associate, shall, on conviction thereof, be expelled from the club.

ARTICLE VII. These By-laws may be amended in the same manner as the Constitution.

Standing Resolutions.

Resolved, That after this date the weekly meetings of this club shall be held on ——, at ——, or at the residences of the members of the club, at —— o'clock.

Resolved, That there shall be an Executive Committee, consisting of the president, recording secretary, and treasurer, having power to transact the necessary business of the club, during the term when the meetings are not held.

Rules of Order.

1. No question shall be stated unless moved by two members, nor open for discussion until stated by the president.

2. When a member intends to speak on a question, he shall rise in his place and respectfully address his remarks to the chair, confine his remarks to the question, and avoid personalities. Should more than one person rise at a time, the president shall determine who is entitled to the floor.

3. When a member is called to order by the president, or any other member he shall at once take his seat, and every point of order shall be decided by the president, without debate, subject to an appeal to the club.

4. In case of an appeal from the decision of the chair the question shall be put to the club thus: "Shall the decision of the chair be sustained?" which shall be decided without debate.

5. No member shall interrupt another while he is speaking, except to call to order.

6. Any member may call for a division of the question, when the sense will admit of it.

7. When any three members call for the yeas and nays, they shall be taken and recorded on the minutes.

8. All resolutions shall, when required by the president or any member, be submitted in writing, and signed by the member offering the same.

9. Cushing's "Manual of Parliamentary Practice" shall be adopted as authority in all matters pertaining to parliamentary order in the club.

10. These Rules may be amended in the same manner as the Constitution and By-laws.

Order of Business.

1. Calling the roll of officers and necessary filling of vacancies.
2. Reading of minutes of last meeting.
3. Reports of committees.
4. Unfinished business.
5. New business.
6. Reception of new members.
7. Has any member any question to ask for information in regard to his farm, stock, etc.?
8. Reading of communications and essays.
9. Discussion of regular topic.
10. Assignment of subject for next discussion.

CONSTITUTION OF VILLAGE-IMPROVEMENT SOCIETIES.

ARTICLE 1. This society shall be called the ——— Improvement Society.

ART. 2. The object of this society shall be to improve and ornament the streets and public grounds of the village by planting and cultivating trees, establishing and protecting grass-plats and borders in the avenues, and generally doing whatever may tend to the improvement of the village as a place of residence.

ART. 3. The business of the society shall be conducted by a board of nine directors, five gentlemen and four ladies, to be elected annually by the society, who shall constitute the board. This board shall, from its own number, elect one president, two vice-presidents, a secretary, and treasurer, and shall appoint such committees as they may deem advisable to further the ends of the society.

ART. 4. It shall be the duty of the president, and, in his absence, of the senior vice-president, to preside at all meetings of the society, and to carry out all orders of the board of directors.

ART. 5. It shall be the duty of the secretary to keep a correct and careful record of all proceedings of the society and of the board of directors in a book suitable for their preservation, and such other duties as ordinarily pertain to the office.

ART. 6. It shall be the duty of the treasurer to keep the funds of the society, and to make such disbursements as may be ordered by the board of directors.

ART. 7. No debt shall be contracted by the board of directors beyond the amount of available funds within their control to pay it, and no member of this society shall be liable for any debt of the society beyond the amount of his or her subscription.

ART. 8. Any adult person may become a member of this society by paying two dollars ($2.00) annually. Any person not of age who shall plant and protect a tree, under the direction of the board of directors, or shall pay the sum of $1.00 annually, may become a member of this society until of age, after which time the annual dues shall be increased to two dollars ($2.00), the same as other adults.

ART. 9. The annual meeting of the society shall be held during the first week in October at such place as the board of directors may select, and a notice of such meeting shall be posted in prominent places through the village. Other meetings of the society may be called by the board of directors when desirable.

ART. 10. At the annual meeting the board of directors

shall report the amount of money received during the year and the source from which it has been received; the amount of money expended during the year, and the objects for which it has been expended; the number of trees planted at the cost of the society, and the number planted by individuals; and, generally, all acts of the board that may be of interest to the society. This report shall be entered on the record of the society.

ART. 11. This constitution may be amended with the approval of two thirds of the members present at any annual meeting of the society, or at any special meeting called for that purpose, a month's notice of the proposed amendment, with its object, having been given.

CONSTITUTION OF ROAD LEAGUES.

ARTICLE 1. This organization shall be known as the ——— Road League of ——— County, ——— (State).

ART. 2. Its object shall be the improvement of public roads in ——— and vicinity.

ART. 3. Any person may become a member on payment of one dollar per annum, and shall be entitled to vote at annual meetings.

ART. 4. The annual meeting shall be held in November on Mondays on or preceding the full moon.

ART. 5. The business of the Road League shall be intrusted to a council of twelve, who shall be chosen by ballot at the annual meetings, and they shall hold office until their successors are elected.

By-laws.

ART. 1. The council of twelve shall convene as soon as possible after the election, and shall choose from their number a president, also a secretary and treasurer (who may be one and the same person), and the council shall hold meetings monthly at the call of the secretary.

ART. 2. The president shall preside at all meetings, and when absent a member present shall be called to the chair in the usual way.

ART. 3. The secretary shall keep a record of the proceedings of all meetings and conduct the correspondence of the league.

ART. 4. The treasurer shall keep an accurate account of receipts and disbursements in a book for that purpose, and all disbursements shall be authorized or approved by the council.

ART. 5. Meetings of the council may be called by order of the president, or at the request of three of its members, and five shall constitute a quorum.

ART. 6. The president shall appoint a monthly committee of two members of the council, who shall give special supervision to the work of the overseer in charge of the roads under the jurisdiction of the league, and serve until their successors are appointed.

ART. 7. The council shall fill all vacancies occurring by resignation or otherwise, and they may drop from their number any member who shall persistently neglect his duty, or manifest indifference by non-attendance of the monthly meetings.

ART. 8. The constitution and by-laws of this league may be changed by a two thirds vote of the entire council, notice of such change having been given in writing at a preceding meeting.

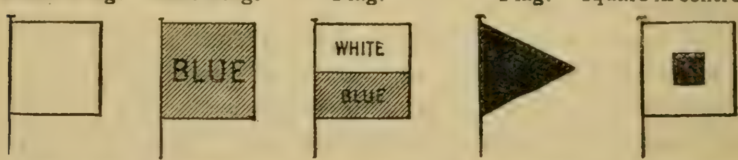
The *order of business* of the council shall be as follows: 1. Roll-call. 2. Reading of minutes of previous meeting. 3. Report of treasurer. 4. Unfinished business. 5. New business. 6. Reports of committees and of the overseers. 7. Adjournment.

II. MISCELLANEOUS SUBJECTS AND TABLES.

EXPLANATION OF THE FLAG SIGNALS ADOPTED BY THE UNITED STATES WEATHER BUREAU.

The U. S. Weather Bureau furnishes, when practicable, for the benefit of the general public and those interests dependent to a greater or less extent upon weather conditions, the "Forecasts" which are prepared daily, at 10 A.M. and 10 P.M., for the following day. These weather forecasts are telegraphed to observers at stations of the Weather Bureau, railway officials, and many others, and are so worded as to be readily communicated to the public by means of flags or steam whistles. The flags adopted for this purpose are five in number, and of the form and dimensions indicated below:

No. 1. White Flag.	No. 2. Blue Flag.	No. 3. White and Blue Flag.	No 4. Black Triangular Flag.	No. 5. White Flag with black square in centre.



Clear or fair weather.	Rain or snow.	Local rains or snow	Temperature signal.	Cold wave.

No. 1, white flag, 6 feet square, indicates clear or fair weather. No. 2, blue flag, 6 feet square, indicates rain or snow. No. 3, white and blue flag (parallel bars of white and blue), 6 feet square, indicates that local rains or showers will occur, and that the rainfall will not be general. No. 4, black triangular flag, 4 feet at the base and 6 feet in length, always refers to temperature; when placed above Nos. 1, 2, or 3, it indicates warmer weather; when placed

below Nos. 1, 2, or 3, it indicates colder weather; when not displayed, the indications are that the temperature will remain stationary, or that the change in temperature will not vary more than 4° from the temperature of the same hour of the preceding day from March to October, inclusive, and not more than 6° for the remaining months of the year. No. 5, white flag, 6 feet square, with black square in centre, indicates the approach of a sudden and decided fall in temperature. This signal is not to be displayed unless it is expected that the temperature will fall to 42° or lower, and is usually ordered at least twenty-four hours in advance of the cold wave.

Interpretation of Displays.

No. 1, alone, indicates fair weather, stationary temperature.

No. 2, alone, indicates rain or snow, stationary temperature.

No. 3, alone, indicates local rain or snow, stationary temperature.

No. 1, with No. 4 above it, indicates fair weather, warmer.

No. 1, with No. 4 below it, indicates fair weather, colder.

No. 2, with No. 4 above it, indicates warmer weather, rain or snow.

No. 2, with No. 4 below it, indicates colder weather, rain or snow.

No. 3, with No. 4 above it, indicates warmer weather, with local rains or snow.

No. 3, with No. 4 below it, indicates colder weather, with local rains or snow.

No. 1, with No. 5 above it, indicates fair weather, cold wave.

No. 2, with No. 5 above it, indicates wet weather, cold wave.

LIST OF HEADQUARTERS OF STATE WEATHER SERVICES.

The headquarters of the state weather services are as follows:

Auburn, Alabama.
Little Rock, Arkansas.
Sacramento, California.
Denver, Colorado.
Atlanta, Georgia.
Springfield, Illinois.
Indianapolis or Lafayette, Indiana.
Des Moines, Iowa.
Topeka, Kansas.
Louisville, Kentucky.
New Orleans, Louisiana.
Baltimore, Maryland.
Cambridge, Massachusetts.
Lansing, Michigan.
Minneapolis, Minnesota.
University, Mississippi.
Columbia, Missouri.
Crete, Nebraska.
Carson City, Nevada.
New Brunswick, New Jersey.
Santa Fé, New Mexico.
Ithaca, New York.
Raleigh, North Carolina.
Bismarck, North Dakota.
Columbus, Ohio.
Portland or Oswego, Oregon.
Philadelphia, Pennsylvania.
Columbia, South Carolina.
Huron, South Dakota.
Nashville, Tennessee.
Galveston, Texas.
Lynchburg, Virginia.
Olympia, Washington.
Parkersburg, West Virginia.
Milwaukee, Wisconsin.

BENEFICIAL AND HARMFUL HAWKS AND OWLS.

(Yearbook U. S. Dept. of Agriculture.)

Much misapprehension exists among farmers as to the habits of birds of prey. Examination of the contents of the stomachs of such birds to the number of several thousand has established the fact that their food consists almost entirely of injurious mammals and insects, and that accordingly these birds are in most cases positively beneficial to the farmer, and should be fostered and protected.

Among those *wholly beneficial* are the large, rough-legged hawk; its near relative, the squirrel-hawk, or ferruginous roughleg; and the four kites: the white-tailed kite, Mississippi kite, swallow-tailed kite, and everglade kite.

The class that is *beneficial in the main*—that is, whose depredations are of little consequence in comparison with

the good it does—includes a majority of the hawks and owls, among them being the following species and their races: March-hawk, Harris's hawk, red-tailed hawk, red-shouldered hawk, short-tailed hawk, white-tailed hawk, Swainson's hawk, short-winged hawk, broad-winged hawk, Mexican black hawk, Mexican goshawk, sparrow-hawk, Audubon's caracara, barn-owl, long-eared owl, short-eared owl, great gray owl, barred owl, Western owl, Richardson's owl, Acadian owl, screech-owl, flammulated screech-owl, snowy owl, hawk-owl, burrowing owl, pygmy owl, ferruginous pygmy owl, and elf-owl.

The class in which *the harmful* and *the beneficial* qualities about balance each other includes the golden eagle, bald eagle, pigeon-hawk, Richardson's hawk, Aplomado falcon, prairie falcon, and the great horned owl.

The *harmful* class comprises the gyrfalcons, duck-hawk, sharp-shinned hawk, Cooper's hawk, and goshawk.

WHAT TO DO IN CASE OF ACCIDENTS.

By J. Noer, M.D., Stoughton, Wis.

Wounds.—The all-important item in the treatment of wounds or cuts is absolute cleanliness or asepsis. Asepsis can be secured by having everything that is to be used for the wound boiled just before applying it.

Before dressing a wound:

1st. Wash your hands, scrub and clean finger-nails thoroughly with soap and hot *boiled* water.

2d. Wash the limb or parts around cut or wound with *boiled* water and soap.

3d. Wash out the wound with *hot boiled* water. If there is still oozing from the cut surfaces,press clean cloths wrung out of *boiled* water as hot as hands can bear against the bleeding surfaces till it stops.

4th. Draw the edges of the wound together with strips of court-plaster.

5th. Lay over the wound so as to cover it well ten to twelve thicknesses of clean boiled and baked dry cheese-cloth, sheeting, or linen, and fasten on with a bandage.

6th. Let the injured parts be at rest. If you have secured asepsis and gotten the edges of the wound together closely, keep the wounded parts at rest for from three to six days; the wound will then heal *without* pain or pus, and without swelling, inflammation, or fever. Don't hinder the healing of a wound by putting pitch, tobacco juice, "healing ointments," liniments, or other filth into it.

Broken or Mangled Limbs should be supported by temporary splints, made from boards, pasteboard, shingles, etc. Put one on each side of the limb and tie on with handkerchief or bandages. The splints should be long enough to support entire limb.

Burns and Scalds—If the burn is extensive, place the person in a bath of lukewarm water, keep the body immersed up to the chin, see that the water is kept warm; patient may be left in bath indefinitely. If the burn is not large, but painful, cover the burned surface with a thick layer of flour, powdered starch, zinc ointment, or cotton batting. Equal parts of limewater and linseed oil may be applied, and the burn covered with cotton. It is important in burns to apply a dressing that will exclude the air. In large burns there is always severe shock: treat this as directed below.

Shock.—When a person has been severely injured or badly frightened, there follows a condition of the system which is known as shock. A person suffering from shock generally becomes pale, cold, faint, and trembling with a small weak pulse. The mind is dull and the person looks anxious and distressed. Sometimes the person is excited and restless.

Treatment.—Let the person rest in a quiet cheerful place. If he is little injured, tell him so calmly. If the injury is severe, and there is pain, broken bones, bleeding, etc., you must still be calm, cheerful, and helpful. Give a tablespoonful (2 or 3, if a drinker) of whiskey in water every quarter or half hour. Wrap him in warm blankets and lay hot water bottles around him. If there is much pain, give 10 drops of laudanum. In case of bleeding, open wounds, or broken bones, treat them as directed. A flushed face and fever show that the patient is reviving and does

not need hot-water bottles or whiskey. Never let an injured person be surrounded by a crowd of people.

Hemorrhage or Bleeding always occurs after an injury. It is the result of the tearing or cutting off of the blood-vessels. A person suffering from hemorrhage either internal or external is pale, faint, with feeble pulse.

Treatment.—Keep the person quiet. If the bleeding comes from a wound in the upper or lower limbs, it will stop by raising the limb up above the rest of the body. Tie clean cloths tightly over the sore. If the blood comes in spurts, tie a rope or handkerchief tightly around limb *above* cut nearest to body. If bleeding is slight, it will stop by tying clean cloths tightly over the cut. Ice may be applied over the bleeding vessels. Clean cloths wrung out of water as *hot* as hands can bear is often effective.

Never use cobwebs, tobacco juice, or other filthy things to stop bleeding. If a person spits or coughs up red frothy blood, he is probably bleeding from the lungs. Let him lie down, and if it continues to come up apply ice to chest and give a teaspoonful of extract of ergot.

Sunstroke and Heat Exhaustion.—In sunstroke the person has a red face; skin is hot and dry; there is high fever; breathing and pulse are very rapid. There is often delirium and convulsions. Put the patient in a cold bath; apply ice to the head and rub the skin with pieces of ice. If he cannot be put into a bath, put him in the shade and pour cold water over him, or wrap him in cold wet blankets and pour cold water over his head. In heat exhaustion the patient is pale and the skin cool. There is no fever. Let the person rest in the shade. Give stimulants, as hot coffee or whiskey.

Poisoning.—In any case of poisoning when the kind of poison is unknown, induce vomiting at once by giving warm water with or without a tablespoonful of ground mustard, or double this amount of salt to the teacup. Thrust your finger down his throat to help the emetic. Milk, raw eggs, gruel, oil should be given freely if irritant poisons, like potash, lye, or acids, have been taken. The following table contains suggestions for the proper treatment of the forms of poisoning occurring most frequently:

Poison.	Treatment.
Acids: Sulfuric, Nitric, Muriatic, Oxalic.	Give soap, soda, whitewash, or magnesia, mixed in water. Produce vomiting. Give gruel, milk, eggs (uncooked). Relieve pain by giving 10 drops of laudanum in water.
Carbolic acid and Creosote.	Give Epsom salts, raw eggs. Produce vomiting.
Alkalies: Ammonia, Soda, Potash, Lye.	Give vinegar, lemon or orange juice, or any acid diluted in plenty of water. Give milk, gruel, white of egg, oils. For pain give 10 drops of laudanum.
Arsenic, Paris Green, Poison fly-paper, Rough on rats.	Produce vomiting if there is none already. Hydrated oxid of iron with magnesia in water is the antidote. Give 2 tablespoonsful of castor oil.
Corrosive sublimate.	Produce vomiting. Give a teaspoonful of tannin in water. Give raw eggs, milk, castor oil.
Iodin.	Produce vomiting. Give starch and water, raw eggs, milk, or gruel.
Opium, Morphin, Laudanum, Paregoric.	Produce vomiting. Inject from a pint to a quart of strong coffee into rectum, or give by mouth if patient can swallow. Keep patient awake.
Poison gas from coal stove.	Fresh air; stimulants, as coffee, ammonia.

INTEREST TABLES.

4%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	5	45
8 "	0	0	0	0	0	0	0	0	1	1	9	89
12 "	0	0	0	0	0	1	1	1	1	2	13	1.34
16 "	0	0	0	0	1	1	1	2	2	2	18	1.78
20 "	0	0	0	1	1	2	2	2	2	2	22	2.22
24 "	0	0	1	1	2	2	2	2	3	3	27	2.67
28 "	0	0	1	1	2	2	2	3	3	3	31	3.11
1 MO..	0	0	1	2	2	2	3	3	3	3	33	3.34
2 "	0	2	2	3	4	4	5	6	6	7	67	6.67
3 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
6 "	2	4	6	8	10	12	14	16	18	20	2.00	20.00
1 YR...	4	8	12	16	20	24	28	32	36	40	4.00	40.00

5%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	6	56
8 "	0	0	0	0	0	0	1	1	1	1	11	1.11
12 "	0	0	0	0	1	1	1	2	2	2	17	1.67
16 "	0	0	0	1	1	2	2	2	2	2	22	2.22
20 "	0	0	1	1	2	2	2	2	3	3	27	2.74
24 "	0	0	1	2	2	2	3	3	3	3	33	3.34
28 "	0	1	1	2	2	3	3	3	4	4	38	3.84
1 MO..	0	1	2	2	2	3	3	4	4	4	42	4.17
2 "	1	2	3	4	4	5	6	7	8	9	83	8.34
3 "	2	3	4	5	6	7	9	10	11	13	1.25	12.50
6 "	3	5	8	10	13	15	18	20	23	25	2.50	25.00
1 YR..	5	10	15	20	25	30	35	40	45	50	5.00	50.00

6%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	1	1	1	7	67
8 "	0	0	0	1	1	1	1	1	1	1	13	1.33
12 "	0	0	1	1	1	1	1	2	2	2	20	2.00
16 "	0	1	1	1	1	2	2	2	2	3	27	2.67
20 "	1	1	1	2	2	2	2	3	3	3	33	3.33
24 "	1	1	1	2	2	2	3	3	4	4	40	4.00
1 MO..	1	1	2	2	3	3	4	4	5	5	50	5.00
2 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
3 "	2	3	5	6	8	9	11	12	14	15	1.50	15.00
6 "	3	6	9	12	15	18	21	24	27	30	3.00	30.00
1 YR...	6	12	18	24	30	36	42	48	54	60	6.00	60.00

7%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	8	77
8 "	0	0	0	0	0	0	1	1	1	1	15	1.55
12 "	0	0	0	0	1	1	1	1	2	2	23	2.31
16 "	0	0	0	1	1	1	2	2	2	3	31	3.10
20 "	0	0	1	1	1	2	2	3	3	4	38	3.84
24 "	0	0	1	1	2	2	3	3	4	5	46	4.62
1 MO..	0	1	2	2	3	3	4	4	5	6	58	5.83
2 "	1	2	3	5	6	7	8	9	10	12	1.17	11.67
3 "	2	3	5	7	9	10	12	14	16	18	1.75	17.50
6 "	4	7	11	14	18	21	25	28	32	35	3.50	35.00
1 YR...	7	14	21	28	35	42	49	56	63	70	7.00	70.00

TABLE OF WAGES BY THE WEEK.

(Computed on a basis of ten hours' labor per day.)

Wages.	1 Hr.	2 Hrs.	5 Hrs.	8 Hrs.	9 Hrs.	1 Day.	2 Days.	3 Days.	4 Days.	5 Days.	6 Days.
$3	.05	.10	.25	.40	.45	.50	1.00	1.50	2.00	2.50	3.00
4	.06⅔	.13⅓	.33⅓	.53⅓	.60	.66⅔	1.33⅓	2.00	2.66⅔	3.33⅓	4.00
5	.08⅓	.16⅔	.41⅔	.66⅔	.75	.83⅓	1.66⅔	2.50	3.33⅓	4.16⅔	5.00
6	.10	.20	.50	.80	.90	1.00	2.00	3.00	4.00	5.00	6.00
7	.11⅔	.23⅓	.58⅓	.93⅓	1.05	1.16⅔	2.33⅓	3.50	4.66⅔	5.83⅓	7.00
8	.13⅓	.26⅔	.66⅔	1.06⅔	1.20	1.33⅓	2.66⅔	4.00	5.33⅓	6.66⅔	8.00
9	.15	.30	.75	1.20	1.35	1.50	3.00	4.50	6.00	7.50	9.00
10	.16⅔	.33⅓	.83⅓	1.33⅓	1.50	1.66⅔	3.33⅓	5.00	6 66⅔	8.33⅓	10.00
11	.18⅓	.36⅔	.91⅔	1.46⅔	1.65	1.83⅓	3.66⅔	5.50	7.33⅓	9.16⅔	11.00
12	.20	.40	1.00	1.60	1.80	2.00	4.00	6.00	8.00	10.00	12.00
13	.21⅔	.43⅓	1.08⅓	1.73⅓	1.95	2.16⅔	4.33⅓	6.50	8.66⅔	10.83⅓	13.00
14	.23⅓	.46⅔	1.16⅔	1.86⅔	2.10	2.33⅓	4.66⅔	7.00	9.33⅓	11.66⅔	14.00
15	.25	.50	1.25	2.00	2.25	2.50	5 00	7.50	10.00	12.50	15.00
16	.26⅔	.53⅓	1.33⅓	2.13⅓	2.40	2.66⅔	5.33⅓	8.00	10.66⅔	13.33⅓	16.00
17	.28⅓	.56⅔	1.41⅔	2.26⅔	2.55	2.83⅓	5.66⅔	8.50	11.33⅓	14.16⅔	17.00
18	.30	.60	1.50	2.40	2.70	3.00	6.00	9.00	12.00	15.00	18.00
19	.31⅔	.63⅓	1.58⅓	2.53⅓	2.85	3.16⅔	6.33⅓	9.50	12.66⅔	15.83⅓	19.00
20	.33⅓	.66⅔	1.66⅔	2.66⅔	3.00	3.33⅓	6.66⅔	10.00	13.33⅓	16.66⅔	20.00
24	.40	.80	2.00	3.20	3.60	4.00	8.00	12.00	16.00	20.00	24.00

TABLE OF WAGES BY THE DAY.

(Computed on a basis of ten hours' labor per day.)

	25c.	37½c.	50c.	62½c.	75c.	87½c.	$1.00	$1.12½	$1.25
½ hour..	.01¼	.01⅞	.02½	.03⅛	.03¾	.04⅜	.05	.05⅝	.06¼
1 "	.02½	.03¾	.05	.06¼	.07½	.08¾	.10	.11¼	.12½
2 "	.05	.07½	.10	.12½	.15	.17½	.20	.22½	.25
5 "	.12½	.18¾	.25	.31¼	.37½	.43¾	.50	.56¼	.62½
8 "	.20	.30	.40	.50	.60	.70	.80	.90	$1.00
9 "	.22½	.33¾	.45	.56¼	.67½	.78¾	.90	1.01¼	1.12½
1 day...	.25	.37½	.50	.62½	.75	.87½	$1.00	1.12½	1.25
2 days..	.50	.75	$1.00	$1.25	$1.50	$1.75	2.00	2.25	2.50
3 "	.75	$1.12½	1.50	1.87½	2.25	2.62½	3.00	3.37½	3.75
4 "	$1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
5 "	1.25	1.87½	2.50	3.12½	3.75	4.37½	5.00	5.62½	6.25
6 "	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50

	$1.37½	$1.50	$1.62½	$1.75	$1.87½	$2.00	$2.12½	$2.25	$2.37½
½ hour..	.06⅞	.07½	.08⅛	.08¾	.09⅜	.10	.10⅝	.11¼	.11⅞
1 "	.13¾	.15	.16¼	.17½	.18¾	.20	.21¼	.22½	.23¾
2 "	.27½	.30	.32½	.35	.37½	.40	.42½	.45	.47½
5 "	.68¾	.75	.81¼	.87½	.93¾	$1.00	$1.06¼	$1.12½	$1.18¾
8 "	$1.10	$1.20	$1.30	$1.40	$1.50	1.60	1.70	1.80	1.90
9 "	1.23¾	1.35	1.46¼	1.57½	1.68¾	1.80	1.91¼	2.02½	2.13¾
1 day...	1.37½	1.50	1.62½	1.75	1.87½	2.00	2.12½	2.25	2.37½
2 days..	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
3 "	4.12½	4.50	4.87½	5.25	5.62½	6.00	6.37½	6.75	7.12½
4 "	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50
5 "	6.87½	7.50	8.12½	8.75	9.37½	10.00	10.62½	11.25	11.87½
6 "	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25

GESTATION CALENDAR.

Average Gestation Period.

Mares,	48½ weeks	(340 days,	extremes	307	and	412	days).
Cows,	40½	"	(283	"	"	240	"	311	").
Ewes,	22	"	(150	"	"	146	"	157	").
Sows,	16	"	(112	"	"	109	"	143	").

Time of Service.	Mares, 340 Days.	Cows, 283 Days.	Ewes, 150 Days.	Sows, 112 Days.
Jan. 1	Dec. 6	Oct. 10	May 30	April 22
" 6	" 11	" 15	June 4	" 27
" 11	" 16	" 20	" 9	May 2
" 16	" 21	" 25	" 14	" 7
" 21	" 26	" 30	" 19	" 12
" 26	" 31	Nov. 4	" 24	" 17
" 31	Jan. 5	" 9	" 29	" 22
Feb. 5	" 10	" 14	July 4	" 27
" 10	" 15	" 19	" 9	June 1
" 15	" 20	" 24	" 14	" 6
" 20	" 25	" 29	" 19	" 11
" 25	" 30	Dec. 4	" 24	" 16
Mar. 2	Feb. 4	" 9	" 29	" 21
" 7	" 9	" 14	Aug. 3	" 26
" 12	" 14	" 19	" 8	July 1
" 17	" 19	" 24	" 13	" 6
" 22	" 24	" 29	" 18	" 11
" 27	Mar. 1	Jan. 3	" 23	" 16
April 1	" 6	" 8	" 28	" 21
" 6	" 11	" 13	Sept. 2	" 26
" 11	" 16	" 18	" 7	" 31
" 16	" 21	" 23	" 12	Aug. 5
" 21	" 26	" 28	" 17	" 10
" 26	" 31	Feb. 2	" 22	" 15
May 1	April 5	" 7	" 27	" 20
" 6	" 10	" 12	Oct. 2	" 25
" 11	" 15	" 17	" 7	" 30
" 16	" 20	" 22	" 12	Sept. 4
" 21	" 25	" 27	" 17	" 9
" 26	" 30	Mar. 4	" 22	" 14
" 31	May 5	" 9	" 27	" 19
June 5	" 10	" 14	Nov. 1	" 24
" 10	" 15	" 19	" 6	" 29
" 15	" 20	" 24	" 11	Oct. 4
" 20	" 25	" 29	" 16	" 9
" 25	" 30	April 3	" 21	" 14
" 30	June 4	" 8	" 26	" 19
July 5	" 9	" 13	Dec. 1	" 24
" 10	" 14	" 18	" 6	" 29
" 15	" 19	" 23	" 11	Nov. 3
" 20	" 24	" 28	" 16	" 8

GESTATION CALENDAR.—(*Continued.*)

Time of Service.	Mares, 340 Days.	Cows, 283 Days.	Ewes, 150 Days.	Sows, 112 Days.
July 25	June 29	May 3	Dec. 21	Nov. 13
" 30	July 4	" 8	" 26	" 18
Aug. 4	" 9	" 13	" 31	" 23
" 9	" 14	" 18	Jan. 5	" 28
" 14	" 19	" 23	" 10	Dec. 3
" 19	" 24	" 28	" 15	" 8
" 24	" 29	June 2	" 20	" 13
" 29	Aug. 3	" 7	" 25	" 18
Sept. 3	" 8	" 12	" 30	" 23
" 8	" 13	" 17	Feb. 4	" 28
" 13	" 18	" 22	" 9	Jan. 2
" 18	" 23	" 27	" 14	" 7
" 23	" 28	July 2	" 19	" 12
" 28	Sept. 2	" 7	" 24	" 17
Oct. 3	" 7	" 12	Mar. 1	" 22
" 8	" 12	" 17	" 6	" 27
" 13	" 17	" 22	" 11	Feb. 1
" 18	" 22	" 27	" 16	" 6
" 23	" 27	Aug. 1	" 21	" 11
" 28	Oct. 2	" 6	" 26	" 16
Nov. 2	" 7	" 11	" 31	" 21
" 7	" 12	" 16	April 5	" 26
" 12	" 17	" 21	" 10	Mar. 3
" 17	" 22	" 26	" 15	" 8
" 22	" 27	" 31	" 20	" 13
" 28	Nov. 1	Sept. 5	" 25	" 18
Dec. 2	" 6	" 10	" 30	" 23
" 7	" 11	" 15	May 5	" 28
" 12	" 16	" 20	" 10	April 2
" 17	" 21	" 25	" 15	" 7
" 22	" 26	" 30	" 20	" 12
" 27	Dec. 1	Oct. 5	" 25	" 17
" 31	" 5	" 9	" 29	" 21

DURATION AND FREQUENCY OF HEAT IN FARM ANIMALS. (Wolff.)

	In Heat for	If not Impregnated, Heat will Recur after	After Coming In, Heat will Recur after
Mares	5-7 days	3-4 weeks	5-9 days
Cows..............	2-3 "	3-4 "	21-28 "
Ewes	2-3 "	17-28 days	7 months
Sheep..............	2-4 "	9-12 "	4-5 weeks*

* 8-9 weeks at the latest.

DOMESTIC POSTAGE.

FIRST CLASS.—Letters and all written matter, whether sealed or unsealed, and all other matter sealed, nailed, sewed, tied, or fastened in any manner, so that it cannot be easily examined, *two cents per ounce* or fraction thereof. A "Special Delivery" ten-cent stamp when attached to a letter, in addition to the lawful postage, shall entitle the letter to immediate delivery at or within one mile of any post-office. Postal cards, one cent each; with paid reply, two cents each.

SECOND CLASS.—All regular newspapers, magazines and other periodicals issued at intervals not exceeding three months; the postage is *one cent for each four ounces*, payable by postage stamps.

THIRD CLASS.—Embraces *printed books*, pamphlets, circulars, engravings, lithographs, proof-sheets and manuscript accompanying the same, and all matter of the same general character, and not having the character of personal correspondence. Circulars produced by hektograph or similar process, or by electric pen, are rated as third class. The limit of weight for mail matter of the third class is four pounds, except in the case of single books exceeding that weight. The rate of postage on mail matter of the third class is *one cent for each two ounces* or fraction thereof.

FOURTH CLASS.—All mailable matter not included in the three preceding classes, which is so prepared for mailing as to be easily taken from the wrapper and examined. Rate. *one cent per ounce* or fraction thereof, except seeds, roots, cuttings, bulbs, plants, and scions, which are one cent per two ounces. Limit of weight, 4 lbs. Full prepayment compulsory. Liquids and other like injurious matter not admitted except under conditions which may be learned at any post-office.

Registry fee, eight cents, which, with the postage, must be fully prepaid. The name and address of sender must be given on the outside of the envelope or wrapper.

FOREIGN POSTAGE.

To all parts of the Universal Postal Union (embracing nearly every civilized country):

ON LETTERS, *five cents for each half ounce* or fraction thereof; prepayment optional. Double rates are collected on delivery of unpaid or short-paid letters.

On newspapers, books, pamphlets, photographs, sheet music, maps, engravings, and similar printed matter, *one cent for each two ounces* or fraction thereof.

To CANADA (including Nova Scotia, New Brunswick, Manitoba, and Prince Edward Island): LETTERS, *two cents for each ounce* or fraction thereof; Books, Circulars, and similar printed matter, *one cent for each two ounces* or fraction thereof; SECOND CLASS MATTER, same as in the United States; SAMPLES AND MERCHANDISE, *one cent per ounce.* Packages must not exceed 4 lbs. 6 oz. in weight; prepayment compulsory.

To MEXICO: Letters, Postal Cards, and printed matter, same rates as in the United States. SAMPLES, *one cent per ounce;* MERCHANDISE other than Samples can only be sent by Parcel Post.

MONEY ORDER FEES.—For Money Orders in denominations of $100 or less, the following fees are charged: Orders not exceeding $2.50, 3c.; over $2.50 to $5, 5c.; $5 to $10, 8c.; $10 to $20, 10c.; $20 to $30, 12c.; $30 to $40, 15c.; $40 to $50, 18c.; $50 to $60, 20c; $60 to $75, 25c.; $75 to $100, 30c.

Express Money Orders may be bought of the leading express companies at the following rates: Not over $5, 5c.; $5 to $10, 8c.; $10 to $20, 10c.; $20 to $30, 12c.; $30 to $40, 15c.; $40 to $50, 18c.; $50 to $60, 20c.; $60 to $75, 25c.; $75 to $100, 30c.

INTERNATIONAL OR FOREIGN MONEY-ORDER FEES.

On Algeria, Belgium, British India, Cape Colony, Constantinople, Denmark, Dominion of Canada, Egypt, England, France, German Empire, Hong Kong, Ireland, Italy, Jamaica, Japan, Newfoundland, New South Wales, New Zealand, Portugal, Sandwich Islands, Scotland, Shanghai, Sweden, Switzerland, Tasmania, Victoria.

For Orders of $10, or less, 10c.	Over $50, not exceeding $60, 60c.
Over $10, not exceeding $20, 20c.	Over $60, not exceeding $70, 70c.
Over $20, not exceeding $30, 30c.	Over $70, not exceeding $80, 80c.
Over $30, not exceeding $40, 40c.	Over $80, not exceeding $90, 90c.
Over $40, not exceeding $50, 50c.	Over $90, not exceeding $100, $1.

Orders can also be obtained on Austria and the East Indies by remittance through the Postal Department of Switzerland, subject to the rates of the Swiss Department to those countries. Also on Norway and the Netherlands, through the Postal Department of the German Empire, subject to the rates of the German Department to those countries.

III. WEIGHTS AND MEASURES.

CUSTOMARY SYSTEM OF WEIGHTS AND MEASURES.

I. Weights.

A. AVOIRDUPOIS WEIGHT.

1 ton = 2000 pounds (lbs.);*

1 lb. = 16 ounces (oz.) = 256 drams = 768 scruples = 7680 grains;
1 oz. = 16 drams = 48 scruples = 480 grains;
1 dram = 3 scruples = 30 grains;
1 scruple = 10 grains.

B. APOTHECARIES' WEIGHT, FOR DRUGS.

1 lb. = 12 oz. = 96 drams = 288 scruples = 5760 grains;
1 oz. = 8 drams = 24 scruples = 480 grains;
1 dram = 3 scruples = 60 grains;
1 scruple = 20 grains.

C. TROY WEIGHT, FOR JEWELS AND PRECIOUS METALS.

1 lb. = 12 oz. = 24 carats = 240 pennyweight (dwt.) = 5760 grains;
1 oz. = 2 carats = 20 dwts. = 480 grains;
1 carat = 10 dwts. = 240 grains;
1 dwt. = 24 grains.

II. Measures.

A. LINEAR.

1 mile = 8 furlongs (frlgs.) = 80 chains = 320 rods = 5280 feet;†
1 furlong = 10 chains = 40 rods = 660 feet;
1 chain = 4 rods = 66 feet;
1 rod = $16\frac{1}{2}$ feet;
1 chain = 100 links;
1 link = 7.92 inches;

1 yard = 3 feet = 36 inches;
1 foot = 12 inches.

B. SURFACE.

1 square mile = 640 acres;
1 acre = 10 square chains = 160 sq. rods = 4840 sq. yds.
= 43,560 square feet.

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* 1 long ton = 20 imperial hundredweights (cwt.) = 2240 pounds.
† 1 sea mile (Admiralty knot) = 6080 feet, or 1.1515 statute mile.

C. CAPACITY.

1. DRY MEASURE.

1 bushel = the volume of 77.627 lbs. of distilled water at 4°C.;

1 bushel = 4 pecks =	8 gallons =	32 quarts =	2150.4 cubic inches;		
1 peck =	2 gallons =	8 quarts =	537.6	"	"
	1 gallon =	4 quarts =	268.8	"	"
		1 quart =	67.2	"	"

2. LIQUID MEASURE.

1 gallon = the volume of 8.3388822 lbs. = 58,373 troy grains of distilled water at 4° C.;

1 gallon = 4 quarts =	8 pints =	32 gills =	231 cubic inches;		
1 quart =	2 pints =	8 gills =	57.75	"	"
	1 pint =	4 gills =	28.88	"	"

Metric System of Weights and Measures.

1. LINEAR MEASURES.

1 meter (m) = 10 decimeters (dm) = 100 centimeters (cm) = 1000 millimeter (mm) = .1 decameters (Dm) = .01 Hectometer (Hm) = .001 Kilometer (Km) = .0001 Myriameter (Mm).

1 Mm =	10 Km =	100 Hm =	1000 Dm =	10,000 m;
	1 Km =	10 Hm =	100 Dm =	1,000 m;
		1 Hm =	10 Dm =	100 m;
			1 Dm =	10 m;

1 m =	10 dm =	100 cm =	1000 mm;
	1 dm =	10 cm =	100 mm;
		1 cm =	10 mm.

2. SURFACE MEASURES.

1 Are (a) = 100 square meters (sq. m.) = .01 hectare (ha);

1 Are = 1 sq. Dm. = 100 square m;

1 sq. Km =	100 Ha =	10,000 A =	1,000,000 sq. m;
	1 Ha =	100 A =	10,000 sq. m;
		1 A =	100 sq. m.

3. MEASURES OF CAPACITY.

1 liter (l) = 1 cubic decimeter (cdm) = 1,000 cubic centimeters (c. c.) = 0.001 cubic meter (cbm) = 10 deciliters (dl) = 100 centiliters (cl) = .01 hectoliter (hl).

1 Hl =	10 Dl =	100 l =	1,000 dl =	10,000 cl;
	1 Dl =	10 l =	100 dl =	1,000 cl;
		1 l =	10 dl =	100 cl.

4. WEIGHTS.

1 kilogram (kg) = 100 decagrams (Dg) = 1000 grams (g);

1 gram = 10 decigrams (dg) = 100 centigrams (cg) = 1,000 milligrams (mg);

1 ton = 1000 Kg =	100,000 Dg =	1,000,000 g;
100 Kg =	10,000 Dg =	100,000 g;
1 Kg =	100 Dg =	1,000 g.

Conversion of U. S. Weights and Measures to Metric, and vice versa.

LINEAR.

	Inches to Millimeters.	Feet to Meters.	Yards to Meters.	Miles to Kilometers.
1 =	25.4001	.3048	.9144	1.6094
	Meter to Inches.	Meter to Feet.	Meter to Yards.	Kilometer to Miles.
1 =	39.3700	3.2808	1.0936	.6214

SQUARE.

	Sq. Inches to Sq. Centmr.	Sq. Feet to Sq. Decimeters.	Square Yards to Square Meters.	Acres to Hectares.
1 =	6.452	9.290	.836	.4047
	Sq. Centime. to sq. in.	Sq. Meters to Sq. Feet.	Square Meters to Square Yards.	Hectares to Acres.
1 =	.1550	10.764	1.196	2.471

CUBIC.

	Cubic In. to Cu. Centmr.	Cubic Feet to Cubic Meters.	Cubic Yards to Cubic Meters.	Bushels to Hectoliters.
1 =	16.387	.0283	.765	.3524
	Cu. Centmrs to Cubic In.	Cu. Decimeters to Cubic Inches.	Cubic Meters to Cubic Feet.	Cubic Meters to Cubic Yards.
1 =	.0610	61.023	35.314	1.308

CAPACITY.

	Fluid Drams to Cu. Centimeters.	Fluid Ounces to Cubic Centimeter.	Quarts to Liters.	Gallons to Liters.
1 =	3.70	29.57	.9464	3.7854

	Cu. Centimeters to Fluid Drams.	Centiliters to Fluid Ounces.	Liters to Quarts.	Decaliters to Gallons.	Hectoliters to Bushels.
1 =	.27	.338	1.0567	2.6417	2.8377

WEIGHT.

	Grains to Milligrams.	Avoirdupois Ounces to Grams.	Avoirdupois Pounds to Kilo-Grams.	Troy Ounces to Grams.
1 =	64.7989	28.3495	.4536	31.1035
	Milligrams to Grains.	Kilograms to Grains.	Hectograms to Ounces Av.	Kilograms to Pounds Av.
1 =	.01543	15432.36	3.5274	2.2046
	Quintals to Pounds Av.	Milliers or Tonnes to Pounds Av.		Kilograms to Ounces Troy.
1 =	220.46	2204.6		32.1507

KILOGRAMS CONVERTED INTO POUNDS AVOIRDUPOIS.

Kilos.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.022	.044	.066	.088	.110	.132	.154	.176	.194
.1	.220	.243	.265	.287	.309	.331	.353	.375	.397	.419
.2	.441	.463	.485	.507	.529	.551	.573	.595	.617	.639
.3	.661	.683	.705	.728	.750	.772	.794	.816	.838	.860
.4	.882	.904	.926	.948	.970	.992	1.014	1.036	1.058	1.080
.5	1.102	1.124	1.146	1.168	1.190	1.213	1.235	1.257	1.279	1.301
.6	1.323	1.345	1.367	1.389	1.411	1.433	1.455	1.477	1.499	1.521
.7	1.543	1.565	1.587	1.609	1.631	1.653	1.676	1.698	1.720	1.742
.8	1.764	1.786	1.808	1.830	1.852	1.874	1.896	1.918	1.940	1.962
.9	1.984	2.006	2.028	2.050	2.072	2.094	2.116	2.138	2.161	2 183

POUNDS CONVERTED INTO KILOGRAMS.

Pounds.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.005	.009	.014	.018	.023	.027	.032	.036	.041
.1	.045	.050	054	.059	.064	.068	.073	.077	.082	.086
.2	.091	.095	.100	.104	.109	.113	.118	.122	.127	132
.3	.136	.141	.145	.150	.154	.159	.163	.168	.172	.177
.4	.181	.186	.191	.195	.200	.204	.209	.213	.218	.222
.5	.227	.231	.236	.240	.245	.249	.254	.259	.263	.268
.6	.272	.277	.281	.286	.290	.295	.299	.304	.308	.313
.7	.318	.322	.327	.331	.336	.340	.345	.349	.354	.358
.8	.363	.367	.371	.376	.381	.386	.390	.395	.399	.404
.9	.408	.413	.417	.422	.426	.431	.435	.440	.445	.449

INCHES REDUCED TO DECIMALS OF A FOOT.

(TRAUTWINE.)

Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.
1/32	.0026	1	.0833	2	.1667	6	.5000	10	.8333
1/16	.0052	1⅛	.0938	2½	.2083	6½	.5417	10½	.8750
⅛	.0104	1¼	.1042	3	.2500	7	.5833	11	.9167
¼	.0208	1⅜	.1146	3½	.2917	7½	.6250	11½	.9583
⅜	.0313	1½	.1250	4	.3333	8	.6667	12	1.0000
½	.0417	1⅝	.1354	4½	.3750	8½	.7083		
⅝	.0521	1¾	.1458	5	.4167	9	.7500		
¾	.0625	1⅞	.1563	5½	.4583	9½	.7917		
⅞	.0729								

OUNCES REDUCED TO DECIMALS OF A POUND.

1 oz. = .06 lb.	9 oz. = .56 lb.
2 " = .13 "	10 " = .63 "
3 " = .19 "	11 " = .69 "
4 " = .25 "	12 " = .75 "
5 " = .31 "	13 " = .81 "
6 " = .38 "	14 " = .88 "
7 " = .43 "	15 " = .94 "
8 " = .50 "	16 " = 1 "

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.

Fahrenheit.	Centigrade.	Réaumur.	Fahrenheit.	Centigrade.	Réaumur.
+212	+100	+80	+158	+70	+56
211	99.44	79.56	157	69.44	55.56
210	98.89	79.11	156	68.89	55.11
209	98.33	78.67	155	68.33	54.67
208	97.78	78.22	154	67.78	54.22
207	97.22	77.78	153	67.22	53.78
206	96.67	77.33	152	66.67	53.33
205	96.11	76.89	151	66.11	52.89
204	95.55	76.44	150	65.55	52.44
203	95	76	149	65	52
202	94.44	75.56	148	64.44	51.56
201	93.89	75.11	147	63.89	51.11
200	93.33	74.67	146	63.33	50.67
199	92.78	74.22	145	62.78	50.22
198	92.22	73.78	144	62.22	49.78
197	91.67	73.33	143	61.67	49.33
196	91.11	72.89	142	61.11	48.89
195	90.55	72.44	141	60.55	48.44
194	90	72	140	60	48
193	89.44	71.56	139	59.44	47.56
192	88.89	71.11	138	58.89	47.11
191	88.33	70.67	137	58.33	46.67
190	87.78	70.22	136	57.78	46.22
189	87.22	69.78	135	57.22	45.78
188	86.67	69.33	134	56.67	45.33
187	86.11	68.89	133	56.11	44.89
186	85.55	68.44	132	55.55	44.44
185	85	68	131	55	44
184	84.44	67.56	130	54.44	43.56
183	83.89	67.11	129	53.89	43.11
182	83.33	66.67	128	53.33	42.67
181	82.78	66.22	127	52.78	42.22
180	82.22	65.78	126	52.22	41.78
179	81.67	65.33	125	51.67	41.33
178	81.11	64.89	124	51.11	40.89
177	80.55	64.44	123	50.55	40.44
176	80	64	122	50	40
175	79.44	63.56	121	49.44	39.56
174	78.89	63.11	120	48.89	39.11
173	78.33	62.67	119	48.33	38.67
172	77.78	62.22	118	47.78	38.22
171	77.22	61.78	117	47.22	37.78
170	76.67	61.33	116	46.67	37.33
169	76.11	60.89	115	46.11	36.89
168	75.55	60.44	114	45.55	36.44
167	75	60	113	45	36
166	74.44	59.56	112	44.44	35.56
165	73.89	59.11	111	43.89	35.11
164	72.33	58.67	110	43.33	34.67
163	72.78	58.22	109	42.78	34.22
162	71.22	57.78	108	42.22	33.78
161	71.67	57.33	107	41.67	33.33
160	71.11	56.89	106	41.11	32.89
159	70.55	56.44	105	40.55	32.44

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.—*Continued.*

Fahrenheit.	Centigrade.	Réaumur.	Fahrenheit.	Centigrade.	Réaumur.
+104	+40	+32	+50	+10	+8
103	39.44	31.56	49	9.44	7.56
102	38.89	31.11	48	8.89	7.11
101	38.33	30.67	47	8.33	6.67
100	37.78	30.22	46	7.78	6.22
99	37.22	29.78	45	7.22	5.78
98	36.67	29.33	44	6.67	5.33
97	36.11	28.89	43	6.11	4.89
96	35.55	28.44	42	5.55	4.44
95	35	28	41	5	4
94	34.44	27.56	40	4.44	3.56
93	33.89	27.11	39	3.89	3.11
92	33.33	26.67	38	3.33	2.67
91	32.78	26.22	37	2.78	2.22
90	32.22	25.78	36	2.22	1.78
89	31.67	25.33	35	1.67	1.33
88	31.11	24.89	34	1.11	0.89
87	30.55	24.44	33	0.55	0.44
86	30	24	32	0	0
85	29.44	23.56	31	−0.55	−0.44
84	28.89	23.11	30	1.11	0.89
83	28.33	22.67	29	1.67	1.33
82	27.78	22.22	28	2.22	1.78
81	27 22	21.78	27	2.78	2.22
80	26.67	21.33	26	3.33	2.67
79	26.11	20.89	25	3.89	3.11
78	25.55	20.44	24	4.44	3.56
77	25	20	23	5	4
76	24.44	19.56	22	5.55	4.44
75	23.89	19.11	21	6.11	4.89
74	23.33	18.67	20	6.67	5.33
73	22.78	18.22	19	7.22	5.78
72	22.22	17.78	18	7.78	6.22
71	21.67	17.33	17	8.33	6.67
70	21.11	16.89	16	8.89	7.11
69	20.55	16.44	15	9.44	7.56
68	20	16	14	10	8
67	19.44	15.56	13	10.55	8.44
66	18.89	15.11	12	11.11	8.89
65	18.33	14.67	11	11.67	9.33
64	17.78	14.22	10	12.22	9.78
63	17.22	13.78	9	12.78	10 22
62	16.67	13.33	8	13.33	10.67
61	16.11	12.89	7	13.89	11.11
60	15.55	12.44	6	14.44	11.56
59	15	12	5	15.00	12
58	14.44	11.56	4	15.55	12.44
57	13.89	11.11	3	16.11	12.89
56	13.33	10.67	2	16.67	13.33
55	12.78	10.22	1	17.22	13.78
54	12.22	9.78	0	17.78	14.22
53	11.67	9.33	−1	18.33	14.67
52	11.11	8.89	2	18.89	15.11
51	10.55	8.44	3	19.44	15.56

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.—*Continued.*

Fahrenheit.	Centigrade.	Réaumur.	Fahrenheit.	Centigrade.	Réaumur.
−4	−20	−16	−23	−30.55	−24.44
5	20.55	16.44	24	31.11	24.89
6	21.11	16.89	25	31.67	25.33
7	21.67	17.33	26	32.22	25.78
8	22.22	17.78	27	32.78	26.22
9	22.78	18.22	28	33.33	26.67
10	23.33	18.67	29	33.89	27.11
11	23.89	19.11	30	34.44	27.56
12	24.44	19.56	31	35	28
13	25	20	32	35.55	28.44
14	25.55	20.44	33	36.11	28.89
15	26.11	20.89	34	36.67	29.33
16	26.67	21.33	35	37.22	29.78
17	27.22	21.78	36	37.78	30.22
18	27.78	22.22	37	38.33	30.67
19	28.33	22.67	38	38.89	31.11
20	28.89	23.11	39	39.44	31.56
21	29.44	23.56	40	40	32.00
22	30	24			

Formula for Converting Degrees Centigrade to Fahrenheit, and vice versa:

$$n^\circ \text{ C.} = \left(\frac{9n^\circ}{5} + 32\right)^\circ \text{F.};$$

$$n^\circ \text{ F.} = \left(\frac{5(n^\circ - 32)}{9}\right) \text{C.}$$

For Degrees Réaumur, substitute 4 for the figure 5 in the preceding formulas.

GOVERNMENT LAND MEASURES.

In the system of government survey, lines running north and south are drawn parallel to a fixed line (principal meridian) at a distance of six miles apart; these are called *range lines*. At right angles with these, other parallel lines (*town lines*) are drawn, which then run east and west. The two sets of lines form squares containing 36 square miles each, called *townships*. A certain number of townships form a *county*. Each square mile of a township is called a *section*, containing 640 acres, and these are numbered regularly 1 to 36, commencing at the northeast corner, as shown in the accompanying diagram. Section 16 in each township is set apart for school purposes.

Sections are divided by lines running north and south, and east and west, into *quarter sections*, designated as the northeast quarter, northwest quarter, southwest quarter, and south-east quarter of the section. These quarters contain 160 acres of land each, and are again divided into quarters, each containing forty acres, which is the smallest sub-division recognized in government survey. Lands are usually sold in tracts of forty acres, or a multiple thereof, except in case of land bordering on lakes, which are fractional sections and may contain more or less than forty acres. These are called *government lots*.

TOWNSHIP.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SECTION.

<table>
<tr><td rowspan="2">N. W.
Quarter.</td><td>NW¼
of
NE¼</td><td>NE¼
of
NE¼</td></tr>
<tr><td>SW¼
of
NE¼</td><td>SE¼
of
NE¼</td></tr>
<tr><td>S. W.
Quarter.</td><td colspan="2">S. E.
Quarter.</td></tr>
</table>

The description of a 40-acre lot would then, for example, read as follows: The northeast quarter of the northeast quarter of section 1 in township 24 north, range 7 west.

TO MEASURE CORN ON THE COB IN CRIBS.

(WARING.)

When the Crib is Equilateral.

RULE.—Multiply the length in inches by the breadth in inches, and that again by the height in inches, and divide the product by 2748 (the number of cubic inches in a heaped bushel), and the quotient will be the number of bushels of ears. Take two thirds of the quotient for the number of bushels of shelled corn.

Example.—Required the number of bushels of shelled corn contained in a crib of ears, 15 ft. long by 5 ft. wide and 10 ft. high.

Solution: 180 in. (length) $\times$ 60 in. (width) $\times$ 120 in. (height) $=$ 1,296,000 $\div$ 2748 $=$ 471.6 heaped bushels, two thirds of which is 314.6 bushels, shelled.

When the Crib is Flared at the Sides.

Multiply half the sum of the top and bottom widths in inches by the perpendicular height in inches, and that again by the length in inches, and divide the product by 2748; the quotient will be the number of heaped bushels of ears. Take two thirds of the quotient for the number of bushels of shelled corn.

LEGAL WEIGHTS OF GRAIN, SEEDS, ETC.

The table shows the number of pounds per bushel required by law or custom, in the sale of articles specified, in the several States of the Union.

States.	Barley.	Buckwheat.	Coal.	Corn, Shelled.	Corn Meal.	Onions.	Oats.	Potatoes.	Rye.	Wheat.	Salt.	Turnips.	Beans, White.	Clover-seed.	Timothy.
Maine	48	48	...	56	50	52	32	60	...	60	...	60	62	...	45
New Hampshire	...	...	...	56	50	...	32	60	56	60	...	...	62	...	...
Vermont	48	48	...	56	...	52	32	60	56	60	70	60	62	60	45
Massachusetts	48	48	..	56	50	52	32	60	56	60	...	...	60	60	45
Rhode Island	48	...	...	56	50	50	32	60	56	60	...	...	...	...	...
Connecticut	48	48	...	56	50	50	32	60	56	60	...	50	60	...	...
New York	48	48	...	58	...	...	32	60	56	60	...	...	62	60	44
New Jersey	48	50	...	56	..	57	30	60	56	60	...	...	...	64	45
Pennsylvania	47	48	...	56	48	50	30	60	56	60	85	...	...	62	...
Delaware	...	...	...	56	48	...	...	...	...	60	...	...	...	...	...
Maryland	...	...	...	...	...	...	26	56	56	...	56	...	62	...	...
District of Columbia	47	48	...	56	48	57	32	56	56	60	50	55	62	60	45
Virginia	48	52	...	56	50	57	32	60	56	60	...	56	60	64	45
West Virginia	48	52	80	56	...	...	32	60	56	60	...	...	60	60	45
North Carolina	48	50	...	54	46	...	30	...	56	60	...	...	...	64	...
South Carolina	48	56	80	56	50	57	32	60	56	60	50	...	60	60	...
Georgia	47	52	80	56	48	57	32	60	56	60	56	55	...	60	45
Florida	48	48	...	56	48	57	32	60	56	60	...	55	60	60	45
Alabama	47	48	...	56	48	57	32	60	56	60	...	55	60	60	45
Mississippi	48	...	...	56	48	..	32	60	56	60	...	...	60	60	45
Louisiana	...	...	...	56	50	...	32	...	...	...	...	...	..	...	...
Texas	48	42	...	56	...	57	32	60	56	60	...	55	60	60	45
Arkansas	48	52	80	56	48	57	32	60	56	60	50	57	60	60	60
Tennessee	48	50	...	56	50	56	32	60	56	60	...	50	60	60	45
Kentucky	47	56	...	56	50	57	32	60	56	60	50	60	60	60	45
Ohio	48	50	..	56	...	55	32	60	56	60	...	60	60	60	45
Michigan	48	48	80	56	50	54	32	60	56	60	56	58	60	60	45
Indiana	48	50	70	56	50	48	32	60	56	60	50	...	60	60	45
Illinois	48	52	..	56	48	57	32	60	56	60	50	55	60	60	45
Wisconsin	48	48	...	56	50	57	32	60	56	60	...	42	60	60	45
Minnesota	48	50	...	56	...	57	32	60	56	60	...	52	60	60	45
Iowa	48	52	...	56	...	57	32	60	56	60	50	...	60	60	45
Missouri	48	52	...	56	50	57	32	60	56	60	50	42	60	60	45
Kansas	48	50	...	56	50	57	32	60	56	60	50	55	60	60	45
Nebraska	48	52	...	56	...	52	32	60	56	60	50	55	60	60	45
South Dakota	48	42	...	56	...	52	32	60	56	60	...	60	60	60	42
North Dakota	48	42	...	56	...	57	32	60	56	60	..	60	60	60	42
Montana	48	52	..	56	50	57	32	60	56	60	...	50	60	60	45
Colorado	48	52	...	56	50	...	32	60	56	60	...	...	60	60	45
Idaho	48	42	...	56	...	...	36	60	56	60	...	...	...	60	...
Washington	48	42	...	56	.	...	32	60	56	60	...	...	...	...	40
California	50	40	...	52	...	...	32	...	54	60	...	...	...	...	...
Oregon	46	42	...	56	...	...	36	60	56	60	...	...	...	60	...
Oklahoma	48	42	...	56	...	52	32	60	56	60	...	60	...	60	42

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES.

(TRAUTWINE.)

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Aluminum	2.6	162.
Anthracite, 1.3–1.84, usually	1.5	93.5
" broken, of any size, loose		52–56
(A ton, loose, averages from 40 to 43 cubic feet.)		
Ash, American white, dry	.61	38.
" " " perfectly dry	.752	47.
Asphaltum, 1–1.8	1.4	83.3
Boxwood, dry	.96	60.
Brass (copper and zinc) cast, 7.8–8.4	8.1	504.
Bronze (copper 8 parts, tin 1 part, gun metal), 8.4–8.6	8.5	529.
Cement, English Portland	....	81–102
Charcoal, of pines and oaks	....	15–30
Cherry, perfectly dry	.672	42.
Chestnut, perfectly dry	.66	41.
Coal, bituminous 1.2–1.5	1.35	84.
broken, of any size, loose		47–52
(A ton occupies from 43 to 48 cubic feet.)		
Copper, cast, 8.6–8.8	8.7	542.
Cork	.25	15.
Coke, loose, of good coal	....	23–32
(A ton occupies 80 to 97 cubic feet.)		
Elm, perfectly dry	.56	35.
Fat	.93	58.
Glass, 2.5–3.45		
Gold, cast, pure	19.258	1204.
Gravel, about the same as sand, which see.		
Hemlock, perfectly dry	.4	25.
Hickory, perfectly dry	.85	53.
Ice, .917–.922	.92	57.4
India rubber	.93	58.
Iron, cast, 6.9–7.4	7.15	446.
Lard	.95	59.3
Lead, 11.38–11.47	11.38	709.6
Lime, quick	1.5	95.
" " ground loose, per struck bu. 62–72 lbs.		
Limestone and marbles	2.6	164.4
Mahogany, Spanish, dry	.85	53.
Maple, dry	.79	49.
Mercury, at 60° F	13.58	846.
Oak, white, perfectly dry, .66–.88	.77	48.

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES.—*Continued.*

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Oak, red, black, etc		32–45
" live, .88–1.02	.95	59.3
Oils, olive, whale	.92	57.3
Peat	....	20–30
Petroleum	.878	54.8
Pine, white, perfectly dry, .35–.45	.40	25.
" yellow, Northern, .48 to .62	.55	34.3
" " Southern, .64–.80	.72	45.
Platinum, 21–22	21.5	1342.
Quartz, common, pure, 2.64–2.67	2.65	165
Rosin	1.1	68.6
Salt, coarse, per struck bu., Syracuse, N. Y., 56 lbs.	....	45.
Sand of pure quartz, dry and loose, per struck bu. 112–133 lbs	....	90–106
Sand of pure quartz, wet	...	118–129
Silver	10.5	655.
Snow, fresh fallen		5–12
" moistened and compacted by rain		15–20
Soils, common loam, perfectly dry, loose		72–80
Soils, common loam, perfectly dry, moderately rammed	....	90–100
Soils, common loam, slightly moist, loose	....	70–76
" " " as a soft, flowing mud	....	104–112
Spruce, perfectly dry	.4	25.
Sulphur	2.0	125.
Steel, 7.7–7.9	7.85	490.
Sycamore, perfectly dry	.59	37.
Tar	1.0	62.4
Tin, cast	7.35	459.
Walnut, perfectly dry	.61	38.
Water, pure rain or distilled, at 32° F. (barometer 30 in.)	....	62.417
Water, pure rain or distilled, at 62° F. (barometer 30 in.)	1.0	62.355
Water, pure rain or distilled water at 212° F. (barometer 30 in.)	....	59.7
Water, sea, 1.026–1.030	1.028	64.08
Wax, bees'	.97	60.5
Zinc, 6.8–7.2	7.0	437.5

NOTE.—Green timbers usually weigh from one fifth to nearly one half more than dry and ordinary building timbers when tolerably seasoned; about one sixth more than perfectly dry.

VALUES OF FOREIGN COINS.

Countries.	Standard.	Monetary Unit.	Value in Terms of U.S. Gold	Coins.
Argentine Republic	Gold and s.	Peso (= 100 centesimos)	$ .96,5	*Gold*—Argentine ($4.82,4) and ½ Argentine ; *silver*—peso and divisions.
Austria-Hungary	Gold.	Crown (= 100 heller)	.20,3	*Gold*— 20 crowns ($4.05,2) and 10 crowns.
Belgium	Gold and s.	Franc (= 100 centimes)	.19,3	*Gold*—10 and 20 francs ; *silver*—5 francs.
Brazil	Gold.	Milreis (= 1000 reis)	.54,6	*Gold*—5, 10, and 20 milreis ; *silver*—½, 1, and 2 milreis.
Chili	Gold and s.	Peso (= 100 centavos)	.91,2	*Gold*—escudo ($1.82,4), doubloon ($4.56,1), and condor ($9.12,8); *silver*—peso and divisions.
Cuba	Gold and s.	"	.92,6	*Gold*—doubloon ($5.01,7); *silver*—peso.
Denmark	Gold.	Crown (krone) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns.
Egypt	Gold.	Pound (= 100 piasters)	4.94,3	*Gold*—10, 20, 50, and 100 piasters; *silver*—1, 2, 10, and 20 piasters.
Finland	Gold.	Mark (= 100 penni)	.19,3	*Gold*—10 and 20 marks ($1.93 and $3.85,9).
France	Gold and s.	Franc (= 100 centimes)	.19,3	*Gold*—5, 10, 20, 50, and 100 francs; *silver*—5 francs.
Germany	Gold.	Mark (= 100 pfennig)	.23,8	*Gold*—5, 10, and 20 marks.
Great Britain	Gold.	Pound sterling (= 20 shillings)	4.86,6½	*Gold*—sovereign (pound sterling and half sovereign).
Greece	Gold and s.	Drachma (= 100 lepta)	.19,3	*Gold*—5, 10, 20, 50, and 100 drachmas; *silver*—5 drachmas.
Haiti	Gold and s.	Gourde	.96,5	*Silver*—gourde.
Italy	Gold and s.	Lira (= 100 centesimi)	.19,3	*Gold*—5, 10, 20, 50 and 100 lire; *silver*—5 lire.
Liberia	Gold.	Dollar (= 100 cents)	1.00	
Netherlands	Gold and s.	Florin (= 100 cents)	.40,2	*Gold*—10 florins; *silver*—½, 1, and 2½ florins.
Norway	Gold.	Crown (krone) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns
Portugal	Gold.	Milreis (= 100 reis)	1.08	*Gold*—1, 2, 5, and 10 milreis.
Spain	Gold and s.	Peseta (= 100 centesimos)	.19,3	*Gold*—25 pesetas; *silver*—5 pesetas.
Sweden	Gold.	Crown (krone) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns.
Switzerland	Gold and s.	Franc (= 100 centimes)	.19,3	*Gold*—5, 10, 20, 50, and 100 francs; *silver*—5 francs.
Turkey	Gold.	Piaster (= $\frac{1}{100}$ lira)	.04,4	*Gold*—25, 50, 100, 200, and 500 piasters.
Venezuela	Gold and s.	Bolivar	.19,3	*Gold*—5, 10, 20, 50, and 100 bolivars; *silver*—5 bolivars.

Fluctuating Currency.

			about
Bolivia	Silver	Boliviano (= 100 centavos)	$.49,3
Central America	Silver	Peso	.49,3
China	Silver	Shanghai tael	.79,3
		Haikwan tael (customs)	.81,1
Colombia	Silver	Peso	.49,3
Ecuador	Silver	Peso	.49,3
India	Silver	Rupee (= 16 annas)	.23,4
Japan	Gold (nominally)	Yen (= 100 sens)	.99,7
	Silver		.53,0
Mexico	Silver	Dollar (peso) (= 100 centavos)	.53,5
Peru	Silver	Sol (= 100 centesimos)	.49,3
Russia	Silver (nominally)	Ruble (= 100 kopecks)	.77,2
	gold		39,5
Tripoli	Silver	Mahbub (= 20 piasters)	.44,5

IV. STATISTICAL TABLES.

AREA AND POPULATION OF THE UNITED STATES, 1890. (Eleventh Census.)

States.	Area in Sq. Miles.	Population.	States.	Area in Sq. Miles.	Population.
Alabama	52,250	1,513,017	Nebraska	77,510	1,058,910
Arizona	113,020	59,620	Nevada	110,700	45,761
Arkansas	53,850	1,128,179	N'wHampshire	9,305	376,350
California	158,360	1,208,130	New Jersey	7,815	1,444,933
Colorado	103,925	412,198	New Mexico	122,580	153,593
Connecticut	4,990	746,258	New York	49,170	5,997,853
Delaware	2,050	168,493	N. Carolina	52,250	1,617,947
Dist. of Colum.	70	230,392	N. Dakota	70,795	182,719
Florida	58,680	391,422	Ohio	41,060	3,672,316
Georgia	59,475	1,837,353	Oklahoma	39,030	61,834
Idaho	84,800	84,385	Oregon	96,030	313,767
Illinois	56,650	3,826,351	Pennsylvania	45,215	5,258,014
Indiana	36,350	2,192,404	Rhode Island	1,250	345,506
Indian Ter.	31,400	182,984	S. Carolina	30,570	1,151,149
		58,385*	S. Dakota	77,650	328,808
Iowa	56,025	1,911,896	Tennessee	42,050	1,767,518
Kansas	82,080	1,427,096	Texas	265,780	2,235,523
Kentucky	40,400	1,858,635	Utah	84,970	207,905
Louisiana	48,720	1,118,587	Vermont	9,565	332,422
Maine	33,040	661,086	Virginia	42,450	1,655,980
Maryland	12,210	1,042,390	Washington	69,180	349,390
Massachusetts	8,315	2,238,943	W. Virginia	24,780	762,794
Michigan	58,915	2,093,889	Wisconsin	56,040	1,686,880
Minnesota	83,365	1,301,826	Wyoming	97,890	60,705
Mississippi	46,810	1,289,600			
Missouri	69,415	2,679,184	Total	3,602,990	62,622,250
Montana	146,080	132,159			

* Indians on reservations in various states and territories.

AREA AND POPULATION OF CANADA, 1891.

Provinces and Districts.	Area in Sq. Miles.	Population.	Provinces and Districts.	Area in Sq. Miles.	Population.
Ontario	21,950	2,114,321	Brit. Columbia	382,300	98,173
Quebec	227,500	1,488,535	Pr. Ed. Island	2,000	109,078
Nova Scotia	20,550	450,396	The Territories	2,371,481	98,967
New Brunswick	28,100	321,263			
Manitoba	64,066	152,506	Total	3,415,647	4,833,239

NORMAL MEAN TEMPERATURE OF THE AIR IN THE UNITED STATES.

(In Degrees Fahrenheit.)

(U. S. Weather Bureau.)

Divisions.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
New England States	26.6	28.1	33.1	43.4	53.9	62.8	68.5	67.1	61.1	50.8	41.6	32.1
Middle Atlantic States	33.2	35.8	40.3	51.7	62.5	71.2	76.0	73.4	67.4	56.8	46.2	37.4
South Atlantic States	47.0	50.6	53.8	61.7	70.5	76.9	80.6	78.4	73.8	65.2	55.9	49.0
Florida Peninsula	64.4	65.8	68.4	73.0	76.9	80.6	82.7	82.0	80.0	76.3	71.0	66.9
East Gulf States	49.7	55.2	58.2	66.7	73.0	78.9	81.4	79.9	76.0	67.6	58.1	52.6
West Gulf States	46.2	52.5	58.8	67.0	73.2	79.5	82.8	81.0	75.9	67.9	57.8	51.1
Ohio Valley and Tennessee	33.6	38.8	44.9	55.5	65.2	73.2	77.3	74.3	68.4	57.8	46.9	38.5
Lower Lake Region	24.7	26.7	32.4	44.2	56.3	65.9	71.8	68.4	62.4	51.5	40.7	31.2
Upper Lake Region	17.2	19.3	26.9	40.3	51.3	61.5	67.9	65.1	58.5	47.4	34.9	25.0
North Dakota	.2	6.0	21.2	40.6	53.4	63.5	68.6	65.8	55.4	42.5	26.0	11.1
Upper Mississippi Valley	19.6	25.3	36.1	50.8	60.8	70.3	75.5	71.8	64.2	52.8	39.4	28.2
Missouri Valley	19.8	25.6	36.7	52.2	61.0	71.4	76.1	72.9	65.1	33.3	39.6	28.6
Northern Slope	15.3	21.5	33.0	45.1	53.9	63.6	70.1	68.2	58.2	46.1	32.9	24.4
Middle Slope	25.6	33.1	41.8	52.4	61.6	71.1	76.5	74.0	65.7	54.2	41.6	33.8
Southern Slope	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Plateau	42.6	48.7	55.2	62.1	70.3	78.6	81.4	79.5	72.4	63.8	52.7	47.0
Middle Plateau	28.5	34.2	41.7	49.2	56.0	63.6	71.4	70.6	61.3	49.8	39.6	33.7
Northern Plateau	22.1	25.7	37.6	47.6	56.0	61.4	69 6	69.2	59.0	48.3	36.9	30.3
N. Pac. Coast Region	39.0	40.8	45.6	49.4	54.3	57.8	61.2	60.9	57.7	52.1	46.3	42.7
Middle Pac. Coast Region	47.1	49.3	53.0	55.5	59.3	62.3	64.6	65.1	63 3	60.5	53.5	49.3
South Pac. Coast Region	50.4	53.2	56.5	60.4	64.4	69.1	73.6	74.5	71.1	64.5	58.2	53 0

NORMAL PRECIPITATION IN THE UNITED STATES. (In Inches.)

(U. S. Weather Bureau.)

Divisions.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
New England States	4.16	3.90	4.71	3.26	3.39	3.11	3.70	4.24	3.49	4.90	4.03	3.55	36.44
Middle Atlantic States	3.68	3.33	3.93	3.52	3.69	3.95	4.72	4.83	4.08	3.35	3.29	3.31	45.68
South Atlantic States	4.21	3.73	4.63	3.73	4.19	5.26	6.25	6.60	5.39	4.19	3.13	3.83	55.14
Florida Peninsula	2.92	2.84	2.21	2.04	4.88	6.06	6.89	6.03	7.25	4.84	2.67	2.14	50.77
East Gulf States	6.10	4.78	5.88	4.50	4.33	5.17	6.15	5.52	4.65	2.88	4.03	4.56	58.55
West Gulf States	3.70	3.65	3.35	4.01	4.50	4.85	4.09	3.59	4.73	3.37	4.11	3.48	47.43
Ohio Valley and Tennessee	4.51	4.22	4.49	3.97	3.89	4.33	4.07	3.85	3.07	2.98	3.74	3.51	46.63
Lower Lake Region	2.72	2.72	2.64	2.39	3.23	3.71	2.36	3.02	3.08	3.25	3.18	2.89	35.13
Upper Lake Region	2.08	1.99	2.14	2.33	3.26	3.71	3.19	3.14	3.56	2.28	2.45	2.25	33.38
North Dakota	.63	.61	.74	1.66	2.30	3.56	2.86	2.18	1.71	1.54	.55	.74	19.08
Upper Mississippi Valley	1.81	2.02	2.20	2.91	4.09	4.78	3.72	3.25	3.43	2.90	2.16	2.03	35.30
Missouri Valley	1.12	1.47	1.84	3.19	4.54	4.66	4.08	3.61	2.72	2.15	1.68	1.16	32.22
Northern Slope	.64	.49	.66	1.53	2.41	2.55	1.78	1.37	.90	.78	.49	.57	14.17
Middle Slope	.79	.74	1.37	2.32	3.41	2.98	2.61	2.96	1.56	1.34	.78	.98	21.84
Southern Slope	....	....	....	....	....	....	....	....	....	....	....	....	..
Southern Plateau	.66	.85	.45	.30	.32	.50	1.72	1.68	.82	.80	.57	.90	9.57
Middle Plateau	1.49	1.34	1.36	1.33	1.25	.67	.22	.35	.60	.83	1.41	1.86	12.71
Northern Plateau	2.44	2.00	1.58	1.44	1.44	1.46	.50	.29	.76	1.52	1.26	2.19	16.88
N. Pac. Coast Region	10.98	7.10	5.58	3.86	2.76	2.55	1.12	1.28	2.86	6.27	7.63	10.06	62.05
Middle Pac. Coast Region	5.70	4.39	4.12	2.57	1.59	.62	.17	.02	.40	1.85	2.73	5.75	29.91
South Pac. Coast Region	2.07	2.30	1.85	1.32	.20	.10	tr.	.10	.13	.62	1.13	2.81	12.63

METEOROLOGICAL DATA FOR CANADA.

Province or City.	Normal Mean Temperature of the Air.		
	Monthly Temperature.		Mean for the Year.
	Lowest.	Highest.	
Ontario	19.3° F.	69.8° F.	43.8° F.
Quebec	13.5	70.2	42.6
New Brunswick	16.1	62.8	39.9
Nova Scotia	21.2	63.3	41.7
Prince Edward Island	14.7	64.3	40.5
Manitoba	0.6	65.9	32.6
British Columbia	22.8	72.2	48.1
Toronto	22.9	67.4	44.1
Montreal	16.8	72.2	44.3
St. John, N. B.	18.4	59.7	40.3
Halifax, N. S.	22.9	63.5	43.1

Normal rainfall in inches per year: Toronto 29.42, Windsor 23.78, Peterborough 20.55, Montreal 27.26, Quebec 19.26, St. John 33.27, Halifax 43.08, Glace Bay 55.49, Sydney 49.42, Winnipeg 16.83, Spence's Bridge 3.88.

COMPARISON OF LEADING INDUSTRIES IN THE UNITED STATES. (U. S. Census of 1890, in Round Numbers.)

	Capital Involved.	Employees.	Wages.	Raw Materials.	Products.
	Millions.	Thousands.	Millions.	Millions.	Millions.
Agriculture	15,982	8,286	....	....	2,460
Forest products, total	....	...	....	....	1,044
Forest industries, enumerated	562	348	102	245	446
Forest products, not enumerated (estimated)	....	....	....	....	598
Manufactures using wood	543	513	294	442	907
Mineral products, total	....	....	....	....	610
Coal	343	300	109	....	160
Gold and silver	486	57	40	....	99
Iron and steel	414	176	96	327	479
Manufactures of iron and steel	86	60	32	79	131
Leather	102	48	25	136	178
Leather manufactures	118	186	88	153	289
Woolen "	297	219	77	203	338
Cotton "	354	222	70	155	268

FARMING POPULATION OF THE UNITED STATES, 1870, 1880, and 1890.

	Ninth Census.	Tenth Census.	Eleventh Census.
Total population	38,558,371	50,152,866	62,622,250
Total engaged in agriculture	5,992,471	7,670,493	9,013,201*
Total in professional and personal services	2,684,793	4,074,238	5,304,829
Total in manufactures and mining	2,707,421	3,837,112	5,091,669†
Total in trade and transportation	1,191,238	1,810,256	3,325,962
Engaged in all classes of occupations	12,375,923	17,392,099	22,735,661
Engaged in agriculture, per cent.	48.4	44.1	39.6

NUMBER OF FARMS IN UNITED STATES AND THEIR VALUE.

(Eleventh Census.)

States.	No. of Farms.	Value.	States.	No. of Farms.	Value.
Alabama	157,772	$111,051,390	Nevada	1,000	$12,339,410
Arizona	1,426	7,222,230	N. Hampshire	29 151	66,162,600
Arkansas	124,760	118,574,422	New Jersey	30,828	159,262,840
California	52,894	697,116,630	New Mexico	4,458	8,140,800
Colorado	16,389	85,035,180	New York	226,223	968,127,286
Connecticut	26,350	95,000,595	N. Carolina	178,359	183,977,010
Delaware	9,381	39,586,080	N. Dakota	27,611	75,310,305
Dist. of Col.	382	6,471,120	Ohio	251,430	1,046,738,247
Florida	34,228	72,745,180	Oklahoma	8,826	8,581,170
Georgia	171,071	152,006,230	Oregon	25,530	115,819,200
Idaho	6,603	17,431,580	Pennsylvania	211,557	922,240,233
Illinois	240,681	1,262,870,587	Rhode Island	5,500	21,873,479
Indiana	198,167	754,789,110	S. Carolina	115,008	99,104,600
Iowa	201,903	857,581,022	S. Dakota	50,158	107,466,335
Kansas	166,617	559,726,046	Tennessee	174,412	242,700,540
Kentucky	179,264	346,339,360	Texas	228,126	399,971,289
Louisiana	69,294	85,381,270	Utah	10,517	28,402,780
Maine	62,013	98,567,730	Vermont	32,573	80,427,490
Maryland	40,798	175,058,550	Virginia	127,600	254,490,600
Massachus'ts	34,374	127,538,284	Washington	18,056	83,461,660
Michigan	172,344	556,190,670	W. Virginia	72,773	151,880,300
Minnesota	116,851	340,059,470	Wisconsin	146,409	477,524,507
Mississippi	144,318	127,423,157	Wyoming	3,125	14,460,880
Missouri	238,043	625,858,361			
Montana	5,603	25,512,340	Total	4,564,641	$13,279,252,649
Nebraska	113,608	402,358,913			

* Agriculture, fisheries, and mining.

† Manufacturing and mechanical industries.

STATISTICS CONCERNING FARMS IN THE UNITED STATES. (Eleventh Census.)

	United States.	North Atlantic Division.	South Atlantic Division.	North Central Division.	South Central Division.	Western Division.
Number of farms, 1890	4,564,641	658,569	749,600	1,923,822	1,086,772	145,878
Total area of farms, acres	623,218,619	62,743,525	100,157,573	256,586,994	156,448,294	47,282,233
Improved land in farms, acres	357,616,755	42,338,024	41,677,371	184,292,126	66,288,824	23,020,410
" " " ", per cent	57.4	67.5	41.6	71.8	42.4	48.7
Total value of farms and stock, dollars	15,982,287,689	2,969,971,293	1,333,395,489	8,517,238,731	1,849,395,198	1,312,266,978
Estimated value of farm products, dollars	2,460,107,454	418,309,066	292,847,809	1,112,949,820	480.337,764	155.662,995
Gross earnings on capital invested, per cent	15.4	14.1	22.0	13.1	26.0	11.9
Av. value of farm products per acre,* dollars	6.88	9.88	7.03	6.04	7.25	6.76
" " " " " " ",† "	3.95	6.67	2.92	4.34	3.07	3.29
Average size of farms, acres	137	95	134	133	144	324
Av. value per farm with equipment and stock, dols.	3,501	4,510	1,780	4,427	1,702	8,996
Number of farms under 50 acres	1,318,521	204,675	291,979	385,764	407,986	28,117
50, under 100 "	1,121,485	195,364	151,889	526,935	232,497	14,800
100, " 500 "	2,008,694	254,510	275,966	983,218	407,328	87,672
500, " 1000 "	84,395	3,287	21,736	23,437	26,666	9,260
1000 acres, and over	31,546	733	8,030	4,468	12,295	6,020
Farms cultivated by owner	3,269,728	537,376	461,057	1,474,086	668,972	128,237
" rented for money	454,659	52,120	96,098	147,248	151,901	7,292
" " " share of products	840,254	69,073	192,445	302,488	265,899	10,349

* Improved land. † Total area.

NOTE.—*North Atlantic Div.:* Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa. *South Atlantic Div.:* Del., Md., D. C., Va., W. Va., N. C., S. C., Ga., Fla. *North Central Div.:* O., Ind., Ill., Mich., Wis., Minn., Ia., Mo., N. D., S. D., Neb., Kan. *South Central Div.:* Ky., Tenn., Ala., Miss., La., Tex., Okla., Ark. *Western Div.:* Mont., Wyo., Colo., N. M., Ariz., Utah, Nev., Id., Wash., Ore., Cal.

AVERAGE AGRICULTURAL WAGES IN THE UNITED STATES IN 1893–1895, INCLUSIVE.

(U. S. Dept. of Agriculture.)

Years.	Per Month for Season or Year.		Per Day in Harvest.		Per Day other than Harvest.	
	With Board.	Without Board.	With Board.	Without Board.	With Board.	Without Board.
1893......	$13.29	$19.10	$1.03	$1.24	$.69	$.89
1894......	12.16	17.74	.93	1.13	.63	.81
1895......	12.02	17.69	.92	1.14	.62	.81

VALUE OF PRINCIPAL FARM PRODUCTS OF THE UNITED STATES. (U. S. Dept. of Agriculture.)

Products.	1859.		1879.		1889.	
	Total Value.	Per Cent.	Total Value.	Per Cent.	Total Value.	Per Cent.
Meats..........	$300,000,000	17.9	$800,000,000	22.1	$900,000,000	23.9
Corn	360,680,878	21.6	694,818,304	19.2	597,918,829	15.9
Hay..........	152,671,168	9.1	409,505,783	11.3	526,632,062	14.0
Dairy products.	240,400,580	14.4	391,131,618	10.8	411,976,522	11.0
Wheat	124,635,545	7.5	436,968,463	12.0	342,491,707	9.1
Cotton	211,516,625	12.6	271,636,121	7.5	307,008,114	8.2
Poultry	75,000,000	4.5	180,000,000	5.0	200,000,000	5.3
Other products*	206,639,527	12.4	440,438,353	12.1	472,492,249	12.6
Grand total. .	1,671,544,323	100	3,624,498,642	100	3,758,519,483	100

* *Other products* include barley, buckwheat, flax fiber, flaxseed, hemp, hops, Irish potatoes, leaf tobacco, maple sirup, maple sugar, oats, rice, rye, sorghum-molasses, sweet potatoes, and wool.

STATISTICS OF THE PRINCIPAL CROPS IN THE UNITED STATES IN 1895.

(U. S. Department of Agriculture.)

States and Territories.	Indian Corn.		Wheat.		Oats.	
	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.
Maine	14,212	596,904	4,365	83,808	138,441	5,551,484
New Hampshire	26,854	1,079,531	2,494	48,134	29,651	1,094,122
Vermont	47,225	2,153,460	6,382	185,078	116,452	5,100,598
Massachusetts	42,078	1,847,224	......	......	15,274	549,864
Rhode Island	9,217	284,805	......	......	3,765	121,986
Connecticut	46,658	1,768,338	......	......	23,267	742,217
New York	506,016	18,014,170	403,374	7,301,069	1,440,579	45,666,354
New Jersey	279,788	9,233,004	108,139	1,340,924	107,561	3,818,416
Pennsylvania	1,298,886	43,512,681	1,232,315	20,456,429	1,152,565	36,536,311
Delaware	203,871	4,281,291	92,181	1,069,300	24,544	468,790
Maryland	616,836	16,531,205	458,868	7,800,756	88,550	2,320,010
Virginia	1,753,073	32,607,158	699,525	6,505,583	459,043	8,125,061
North Carolina	2,508,856	36,378,412	688,196	4,748,552	506,777	7,652,333
Georgia	3,244,037	42,172,481	214,630	1,330,706	460,624	6,679,048
Florida	552,379	6,186,645	......	......	39,836	406,327
Alabama	2,790,974	44,376,487	49,771	373,283	349,676	5,210,172
South Carolina	1,789,271	19,860,908	134,160	858,624	288,837	4,390,322
Mississippi	2,277,036	35,977,169	4,648	37,184	132,281	2,076,812
Louisiana	1,247,198	22,574,284	......	......	38,383	575,745
Texas	4,087,332	107,905,565	365,200	2,081,640	703,825	14,569,178
Arkansas	2,342,305	50,359,558	154,500	1,454,300	327,027	8,306,486

Tennessee	3,325,321	83,133,025	655,310	5,766,728	454,887	10,234,958
West Virginia	688,545	16,662,789	406,017	4,303,780	151,253	3,539,320
Kentucky	3,010,876	93,939,331	871,672	9,501,225	505,819	13,252,458
Ohio	2,846,110	92,783,186	2,422,224	32,215,579	990,678	31,404,493
Michigan	994,090	33,600,242	1,154,379	15,237,803	973,439	23,265,192
Indiana	3,702,310	121,435,768	2,205,923	20,294,492	1,130,812	25,895,595
Illinois	6,821,833	255,136,554	1,732,792	19,060,712	3,020,784	73,707,130
Wisconsin	1,040,676	33,093,497	555,885	8,616,218	1,864,505	63,020,269
Minnesota	1,152,458	35,956,690	2,851,485	65,584,155	1,954,764	77,995,084
Iowa	8,504,349	298,502,650	700,245	13,654,778	3,960,332	182,967,338
Missouri	6,613,118	238,072,248	1,541,664	18,499,968	1,102,805	30,547,699
Kansas	8,426,327	204,750,746	2,976,567	22,919,566	1,680,223	30,075,092
Nebraska	7,806,526	125,685,069	1,232,252	14,787,024	1,676,962	39,911,696
South Dakota	1,119,229	12,423,442	2,438,424	29,261,088	717,580	18,154,774
North Dakota	30,938	658,979	2,907,510	61,057,710	594,016	19,067,914
Montana	1,331	32,275	44,570	1,065,223	68,326	2,446,071
Wyoming	2,483	68,283	7,623	198,198	14,175	581,175
Colorado	178,308	3,690,976	119,500	2,808,250	98,812	3,389,252
New Mexico	26,956	733,203	39,669	809,248	9,869	393,773
Arizona	5,105	132,730	12,227	250,654	......	......
Utah	8,918	181,035	109,086	2,443,526	27,407	926,357
Nevada	......	......	5,651	122,627	......	......
Idaho	1,656	50,839	68,646	1,221,899	31,317	1,102,358
Washington	5,454	93,263	464,255	7,195,952	91,116	3,671,975
Oregon	13,395	353,628	593,136	11,862,720	251,423	7,240,982
California	65,416	2,256,852	3,084,446	40,097,798	60,144	1,690,046
Oklahoma	......	......	227,426	2,592,656	......	......
Total	82,075,830	2,151,138,580	34,047,332	467,102,947	27,878,406	824,443,537

STATISTICS OF THE PRINCIPAL CROPS IN THE UNITED STATES IN 1895.—(*Continued.*)

States and Territories.	Barley.		Potatoes.		Hay.	
	Acres.	Bushels.	Acres.	Bushels.	Acres.	Tons.
Maine	12,607	408,467	62,203	10,139,089	1,104,932	1,127,031
New Hampshire	5,335	136,576	23,395	3,134,930	621,607	590,527
Vermont	18,668	619,778	33,338	5,134,052	835,476	893,959
Massachusetts	1,839	41,378	32,354	4,303,082	585,440	649,838
Rhode Island	381	8,954	7,324	1,010,712	82,216	74,817
Connecticut	...	...	27,052	3,462,656	471,106	400,440
New York	239,005	5,473,215	424,175	51,749,350	4,873,320	3,557,524
New Jersey	...	...	48,942	4,600,548	495,443	599,486
Pennsylvania	12,814	258,843	208,948	23,193,228	2,843,611	2,872,047
Delaware	...	...	5,651	327,758	55,372	68,108
Maryland	...	...	27,200	2,366,400	349,038	436,298
Virginia	...	...	41,525	3,031,325	685,488	774,601
North Carolina	...	...	18,494	1,461,026	167,816	273,540
South Carolina	...	...	4,460	401,400	144,986	144,986
Georgia	...	...	6,277	364,066	147,838	236,541
Florida	...	...	1,635	89,925	6,719	10,280
Alabama	...	...	6,859	480,130	74,987	116,980
Mississippi	...	...	6,262	363,196	76,119	148,432
Louisiana	...	...	9,301	827,789	36,897	74,532
Texas	2,484	53,654	14,338	1,276,082	457,214	676,677
Arkansas	...	...	21,090	1,476,300	178,663	214,396

Tennessee..	2,491	57,542	38,177	2,443,328	396,314	550,876
West Virginia	...	...	33,299	2,297,631	475,246	337,425
Kentucky	2,672	88,978	45,444	3,908,184	513,865	693,718
Ohio	29,244	824,681	208,048	13,107,024	1,803,558	1,046,064
Michigan	69,356	1,255,344	236,797	23,916,497	1,243,048	720,968
Indiana	6,811	102,165	105,236	6,945,576	1,566,763	955,725
Illinois	17,645	352,900	178,561	13,749,197	1,998,686	1,319,133
Wisconsin	370,938	10,868,483	179,720	19,230,040	1,556,961	1,370,126
Minnesota	484,369	17,437,284	151,842	23,991,036	1,570,591	2,041,768
Iowa	453,031	12,684,868	201,330	21,340,980	4,270,910	4,612,583
Missouri	940	14,382	98,764	10,765,276	2,329,731	2,725,785
Kansas	17,942	258,365	109,295	7,869,240	3,372,007	4,181,289
Nebraska	49,051	1,393,048	119,319	7,994,373	1,829,752	1,811,454
South Dakota	130,445	2,543,678	61,169	4,037,154	1,959,200	1,547,768
North Dakota	290,766	8,839,286	40,566	5,192,448	412,237	585,377
Montana	5,701	142,526	5,442	288,426	311,337	292,657
Wyoming	...	...	2,758	275,800	236,003	254,883
Colorado	14,290	447,277	36,756	3,491,820	810,408	1,961,187
New Mexico	1,852	51,856	742	59,360	46,221	120,637
Arizona	10,165	261,241	422	29,118	34,408	63,655
Utah	6,366	190,980	6,191	1,064,852	179,575	459,712
Nevada	8,180	262,578	1,420	213,000	155,138	466,965
Idaho	10,606	259,847	3,888	408,420	178,832	459,598
Washington	52,070	1,942,211	16,193	2,412,757	324,472	600,273
Oregon	34,782	768,682	17,571	1,124,544	655,749	1,166,165
California	937,127	19,023,678	25,179	1,888,425	1,681,753	2,791,710
Total	3,299,973	87,072,744	2,954,952	297,237,370	44,206,453	47,078,541

AREA, PRODUCT, AND VALUE OF PRINCIPAL CROPS IN THE UNITED STATES IN 1895.

(U. S. Department of Agriculture.)

	Total Production.	Total Area of Crop.	Total Value of Crop.	Av. Value per Unit.	Av. Yield per Acre.	Av. Value per Acre.
		Acres	$	Cents		$
Indian corn, bshls.	2,151,138,580	82,075,830	544,985,534	25.3	26.2	6.64
Wheat, "	467,102,947	34,047,332	237,938,998	50.9	13.7	6.99
Oats, "	824,443,537	27,878,406	163,655,068	19.9	29.6	5 87
Rye, "	27,210,070	1,890,345	11,964,826	44.0	14.4	6.33
Barley, "	87,072,744	3,299,973	29,312,413	33.7	26.4	8.88
Buckwheat, "	15,341,399	763,277	6,936,325	45.2	20.1	9.09
Potatoes, "	297,237,370	2,954,952	78,984,901	26.6	93.8	26.73
Tobacco, lbs.......	491,544,000	633,950	35,574,220	7.2	775.4	56.10
Hay, tons.	47,078,541	44,206,453	393,185,615	$8.35	1.07	8 89
Cotton, bales*.....	9,476,435	23,687,950	259,164,640	27.35	.40	10.94

THE PRINCIPAL CEREAL PRODUCTS OF THE UNITED STATES.

As Shown by the Census Returns, from 1850 to 1890.

Census of	Indian Corn.	Wheat.	Oats.	Barley.	Rye.	Buckwheat.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1850	592,071,104	100,485,944	146,584,179	5,167,015	14,188,813	8,956,912
1860	838,792,742	173,104,924	172,643,185	15,825,898	21,101,380	17,571,818
1870	760,944,549	287,745,626	282,107,157	29,761,305	16,918,795	9,821,721
1880	1,754,861,525	459,479,505	407,858,999	44,113,495	19,831,595	11,817,327
1890	2,112,327,547	468,373,968	809,250,666	78,332,976	28,421,398	12,110,349

PRODUCTION OF VARIOUS CROPS IN CANADA, 1891. (Census of 1891.)

Wheat	42,144,779 bu.	Turnips and other roots..	49,555,902 bu.
Barley.........	17,148,198 "	Grass and clover.....	340,650 "
Oats..................	82,515,413 "	Fruits, grapes, etc....	68,864,181 lbs.
Rye....	1,328,322 "	Tobacco..............	4,277,936 "
Peas and beans... ...	15,514,836 "	Hops........	1,126,230 "
Buckwheat...........	4,886,122 "	Flaxseed.............	137,015 bu.
Corn (maize)..........	10,675,886 "		
Potatoes..............	52,653,704 "		

Area of improved land in Canada, 1891.........	28,537,242	acres.
" " " " under crop.............	19,904,826	"
" " gardens and orchards....	464,462	"
" " pastures... ..	15,284,788	"

* Crop of 1894.

AVERAGE COST PER ACRE OF RAISING WHEAT AND CORN IN THE UNITED STATES, 1893.*

(U. S. Dept. of Agriculture.)

	Wheat.	Corn.
Rent of land	$2.81	$3.03
Manure	2.16	1.86
Preparing ground	1.87	1.62
Seed	.96	....
Sowing or planting	.37	.42
Cultivating	....	1.80
Harvesting or gathering	1.19	1.22
Thrashing	1.20	
Housing	.37	.50
Marketing	.76	1.26
Total	$11.69	$11.71

AVERAGE FARM PRICE OF VARIOUS AGRICULTURAL PRODUCTS ON DEC. 1 IN EACH YEAR FROM 1886 TO 1895.

(U. S. Dept. of Agriculture.)

Crop.	1886	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
	$	$	$	$	$	$	$	$	$	$
Corn per bushel	0.366	0.444	0.341	0.283	0.506	0.406	0.393	0.365	0.457	0.253
Wheat "	0.687	0.681	0.926	0.698	0.838	0.839	0.624	0.538	0.491	0.509
Rye "	0.531	0.544	0.591	0.457	0.629	0.774	0.548	0.513	0.501	0.440
Oats "	0.298	0.304	0.278	0.230	0.424	0.315	0.317	0.294	0.324	0.199
Barley "	0.530	0.522	0.596	0.427	0.648	0.540	0.472	0.411	0.442	0.337
Buckwheat per bush.	0.544	0.561	0.636	0.518	0.577	0.579	0.534	0.583	0.556	0.452
Irish potatoes "	0.450	0.685	0.404	0.403	0.777	0.371	0.673	0.590	0.536	0.266
Hay per ton.	7.36	9.34	....	7.88	7.74	8.39	8.49	8.68	8.54	8.35
Cotton per lb.	0.081	0.085	0.085	0.083	0.086	0.073	0.084	0.070	0.046	0.076
Leaf tobacco per lb.	0.069	0.103	....	0.071	0.077	0.084	....	0.081	0.068	0.069

* Consolidated from returns from nearly 30,000 leading farmers scattered throughout the United States.

ESTIMATED NUMBER OF FARM ANIMALS ON FARMS AND RANCHES, AND AVERAGE PRICE PER HEAD, JANUARY, 1896.

(U. S. Department of Agriculture.)

States and Territories.	Horses.		Mules.		Milch Cows.		Oxen and Other Cattle.		Sheep.		Swine.	
	Number.	Aver. Price.	Number.	Aver. Price.	Number.	Aver. Price.	Number.	Aver. Price.	Number.	Aver. Price.	Number.	Aver. Price.
Maine	116,502	$53.57	....	......	192,077	$28.14	117,802	$24.46	258,836	$2.07	78,403	$7.60
New Hampshire	55,580	49.51	....	......	127,694	29.50	84,723	24.40	87,111	2.12	56,400	7.76
Vermont	91,996	44.24	....	......	258,471	24.82	143,643	21.20	181,550	1.93	78,572	7.42
Massachusetts	65,102	72.49	....	......	174,572	34.63	80,470	26.36	48,395	3.30	60,726	8.44
Rhode Island	10,029	77.00	....	......	24,763	38.33	11,596	23.81	11,279	3.38	14,433	9.80
Connecticut	43,913	66.55	....	......	136,206	29.90	69,390	25.15	34,520	2.66	53,737	8.94
New York	1,654,045	47.77	4,674	$59.42	1,445,232	24.30	597,428	23.12	899,179	2.38	645,433	6.50
New Jersey	82,437	65.47	7,886	84.51	200,347	34.38	47,487	26.35	45,089	4.04	163,231	7.78
Pennsylvania	607,516	47.13	36,509	60.72	947,766	24.22	610,776	20.70	907,672	2.16	1,033,104	6.26
Delaware	29,974	52.08	5,269	66.07	34,174	29.00	25,482	19.99	12,358	2.89	52,167	6.40
Maryland	134,095	44.75	13,213	61.02	150,477	24.50	116,045	19.31	120,884	[illegible]	338,659	5.32
Virginia	245,040	30.86	38,248	55.80	265,635	18.14	386,675	15.88	426,889	2.10	985,748	3.82
North Carolina	144,095	54.30	110,860	50.31	272,046	14.40	363,585	10.12	343,194	1.39	1,427,345	3.92
South Carolina	64,514	59.01	95,955	73.70	129,388	16.88	158,450	10.11	74,465	1.47	945,662	4.33
Georgia	109,185	52.90	166,040	67.50	312,711	16.95	540,916	9.11	378,769	1.37	1,054,241	3.55
Florida	35,162	50.09	8,357	65.09	114,332	13.32	361,054	7.97	101,777	1.85	395,254	2.16
Alabama	128,336	42.52	127,195	53.19	308,439	10.91	523,329	6.70	271,111	1.15	1,848,898	2.86
Mississippi	182,777	39.77	153,877	51.50	293,870	13.81	485,695	7.49	343,996	1.23	1,940,755	3.09

Louisiana.............	137,344	35.45	90,040	56.30	166,889	14.10	312,122	8.34	146,571	1.39	888,720	2.85
Texas.	1,183,777	20.72	264,069	34.56	783,936	17.89	5,518,644	12.60	3,065,256	1.25	3,035,119	3.59
Arkansas.............	235,618	32.76	145,519	43.39	295,827	12.87	516,695	8.49	188,972	1.29	1,503,166	2.53
Tennessee.............	344,440	39.95	182,139	42.05	330,690	15.53	519,124	10.58	439,466	1.48	1,910,749	3.34
West Virginia.........	161,352	32.92	7,601	43.28	175,029	20.54	296,613	15.35	514,783	1.74	375,042	4.02
Kentucky..............	417,582	34.78	131,297	36.10	303,682	20.38	506,997	17.33	858,366	1.87	1,688,594	3.59
Ohio..................	771,35	37.88	19,475	41.18	759,597	24.25	686,285	21.41	2,754,613	1.91	2,456,626	4.41
Michigan..............	454,610	44.74	3,026	47.19	468,523	25.16	398,656	17.61	1,491,070	1.91	720,694	5.83
Indiana...............	694,445	34.18	50,431	37.77	637,404	24.70	798,414	20.60	727,509	2.30	1,654,772	4.72
Illinois..............	1,179,072	29.26	97,453	36.24	1,018,443	27.46	1,430,976	20.42	694,470	2.41	2,392,980	5.14
Wisconsin.............	442,853	42.19	4,925	44.04	802,902	22.21	673,250	17.37	770,350	1.94	902,507	6.27
Minnesota.............	488,647	33.44	8,991	46.99	600,515	21.44	694,321	15.03	435,381	1.94	560,957	5.11
Iowa..................	1,182,056	28.79	34,044	36.13	1,202,560	25.78	2,336,973	21.46	565,137	2.48	4,854,507	5.66
Missouri..............	918,415	25.09	231,684	29.84	723,309	24.00	1,686,990	19.30	774,738	1.91	3,169,411	3.90
Kansas................	857,789	24.03	87,520	32.52	622,892	22.12	1,766,245	19.20	258,390	1.60	1,676,487	5.07
Nebraska..............	632,053	25.70	43,709	35.62	534,197	21.92	1,062,469	17.86	192,620	2.17	1,289,726	5.01
South Dakota..........	287,890	26.31	6,937	33.26	292,874	20.41	399,814	16.50	320,247	1.95	160,064	5.22
North Dakota..........	170,104	34.18	7,607	54.72	156,571	21.63	255,502	19.81	359,828	1.98	117,949	5.14
Montana...............	182,605	21.94	994	26.63	42,086	27.90	1,153,557	17.24	3,061,502	1.55	52,087	6.91
Wyoming...............	81,699	17.22	1,445	32.23	18,332	24.50	751,849	16.48	1,393,693	1.80	15,834	7.20
Colorado..............	164,645	21.98	8,888	45.56	79,975	25.00	926,560	17.17	1,310,049	1.71	23,419	5.72
New Mexico............	83,862	16.68	3,747	34.65	18,383	23.00	793,506	10.15	2,738,030	1.00	31,787	5.63
Arizona...............	56,440	20.63	1,221	27.52	15,622	25.00	636,512	10.14	746,546	1.25	20,695	7.39
Utah..................	71,897	12.55	1,735	23.55	57,271	15.20	369,374	11.51	1,998,441	1.58	56,621	6.95
Nevada................	53,561	18.68	1,604	27.99	18,196	24.50	259,078	12.07	544,077	1.71	11,590	6.25
Idaho.................	134,705	24.71	941	31.90	28,034	20.25	395,852	14.10	1,011,852	2.25	77,518	5.14
Washington............	192,055	29.03	1,420	39.48	117,381	23.08	381,550	15.21	756,346	1.74	239,413	4.35
Oregon................	219,115	21.11	6,182	27.62	113,732	18.43	788,452	12.64	2,630,949	1.36	252,685	3.17
California............	482,818	27.16	59,251	35.02	335,646	23.75	888,832	15.82	2,962,126	1.85	507,461	4.03
Oklahoma..............	38,332	16.17	6,968	22.27	28,888	19.75	155,645	15.20	22,322	1.65	62,811	4.77
Total.................	15,124,057	$33.07	2,278,946	$45.29	16,137,586	$22.55	32,085,409	$15.86	38,298,783	$1.70	42,842,759	$4.35
Total value........	$500,140,186		$103,204,457		$363,955,545		$508,928,416		$65,167,735		$186,529,745	

DAIRY STATISTICS FOR THE UNITED STATES, 1890.

(Eleventh U. S. Census.)

States and Territories.	Milch Cows.	Milk, all Produced on Farms.	Butter Made on Farms.	Butter Made at Creameries.	Cheese Made on Farms.	Cheese Made at Creameries.
	Number.	Gallons.	Pounds.	Pounds.	Pounds.	Pounds.
Maine	157,278	57,969,791	15,593,315	1,406,041	696,052	755,761
New Hampshire	109,423	42,633,268	7,942,840	1,919,590	341,235	103,386
Vermont	231,419	90,712,230	23,314,063	5,085,377	609,586	5,582,327
Massachusetts	172,046	82,571,924	8,358,703	2,051,597	122,900	262,633
Rhode Island	23,943	10,610,547	965,456	233,783	24,631	300,000
Connecticut	127,892	54,413,822	7,196,095	3,173,164	112,566	195,955
New York	1,440,230	663,917,240	98,241,813	14,485,702	4,324,028	119,762,496
New Jersey	161,576	64,003,953	8,367,218	499,531	23,613	563,628
Pennsylvania	927,254	368,906,480	76,809,041	19,390,381	439,060	5,018,837
Delaware	32,574	10,699,362	2,026,498	466,761	359	....
Maryland	142,198	46,601,218	9,999,602	847,277	9,573	14,000
District of Columbia	863	459,978	13,769	....	....	....
Virginia	273,634	78,143,459	17,949,966	811,890	109,187	109,000
West Virginia	188,492	59,449,066	14,003,627	18,000	74,372	21,000
North Carolina	223,416	55,250,665	13,129,374	....	60,760	....
South Carolina	107,717	23,833,631	5,737,557	....	2,476	....
Georgia	287,717	52,234,508	14,483,323	....	12,833	....
Florida	113,388	5,056,790	867,195	....	1,731	....
Ohio	794,833	326,925,396	74,990,307	6,532,485	1,068,083	21,185,971
Indiana	579,287	200,510,797	48,477,766	1,677,088	360,948	830,552
Illinois	1,087,886	367,269,464	57,121,486	25,553,422	343,456	10,005,477
Michigan	497,611	224,537,488	50,197,481	2,145,731	328,682	5,041,778
Wisconsin	792,620	303,701,134	46,295,623	14,059,876	906,266	53,708,595

Minnesota	593,908	182,968,973	34,766,409	13,911,095	676,642	3,615,528
Iowa	1,498,418	486,961,411	72,893,079	53,143,140	1,038,358	4,705,576
Missouri	851,076	193,931,103	43,108,521	1,529,647	288,620	1,384,397
North Dakota	88,289	26,566,112	5,712,566	446,296	131,374	49,000
South Dakota	210,240	59,666,525	13,127,244	532,513	303,951	250,812
Nebraska	505,045	144,768,263	27,818,078	6,076,783	463,831	804,618
Kansas	741,786	201,608,099	46,117,076	4,317,876	759,210	1,974,136
Kentucky	364,516	113,497,289	29,038,406	...	64,822	...
Tennessee	345,311	107,657,116	38,314,387	65,990	69,919	31,300
Alabama	292,088	55,508,687	14,548,435	...	6,131	...
Mississippi	310,159	50,803,371	12,988,637	...	4,898	...
Louisiana	167,223	12,881,927	2,089,774	...	3,939	...
Texas	1,003,439	118,475,320	32,100,560	44,689	145,730	...
Oklahoma	16,756	1,544,280	387,920	...	1,600	...
Arkansas	330,165	54,325,673	15,724,144	...	21,328	...
Montana	24,143	6,038,096	1,062,185	...	11,512	...
Wyoming	11,684	3,064,588	428,269	...	15,196	...
Colorado	76,948	19,680,791	3,282,086	339,000	87,183	44,500
New Mexico	18,507	717,155	86,042	...	18,931	...
Arizona	4,874	709,225	115,203	...	10,855	...
Utah	45,982	8,614,694	1,759,354	55,800	163,539	13,200
Nevada	9,273	2,532,052	489,657	...	51,207	...
Idaho	27,278	5,085,863	1,078,103	13,650	207,213	116,640
Washington	70,721	19,873,281	3,482,225	1,500	71,281	249,700
Oregon	114,156	25,042,276	4,786,277	138,468	265,576	230,540
California	317,201	111,191,186	26,776,704	271,767	3,871,575	1,091,222
The United States	16,511,950	5,209,125,567	1,024,223,468	181,284,916	18,726,818	238,035,065

NUMBER AND VALUE OF FARM ANIMALS IN THE UNITED STATES, 1870-95.

(U. S. Department of Agriculture.)

Farm Animals.	Jan. 1, 1870.	Jan. 1, 1880.	Jan. 1, 1890.	Jan. 1, 1895.
Horses, number.	8,248,800	11,201,800	14,213,837	15,893,318
value...	$671,319,461	$613,296,611	$978,516,562	$576,730,580
Mules, number..	1,179,500	1,729,500	2,331,027	2,333.108
value ...	$128,584,769	$105,948,319	$182,394,099	$110.927,834
Milch cows, No.	10,095,600	12,027,000	15,952,883	16,504,629
value..	$394,094,745	$279,899,420	$352,152,133	$362,601,726
Oxen and other cattle, number	15,388,500	21,231,000	36,849,024	34,364,216
value..	$346,926,440	$341,761,154	$560,625,137	$482,999,129
Sheep, number..	40,853,000	40,765,900	44,336,072	42.294,064
value....	$93,364,433	$90,230,537	$100,659,761	$66,685,767
Swine, number..	26,751,400	34,034,100	51,602,780	44,165,716
value....	$187,191,502	$145,781,515	$243,418,336	$219,501,267
Total value of farm animals..	$1,822,327,377	$1,576,917,556	$2,418,766,028	$1,819,446,306

NUMBER OF FARM ANIMALS IN CANADA, 1891.

(Census of 1891.)

Provinces.	Horses.	Working Oxen.	Milch Cows.	Sheep.	Swine.
Ontario...	771,838	12,424	876,167	1,021,769	1,121,396
Quebec...	344,290	45,676	549,544	730,286	369,608
Nova Scotia..............	65,047	28,424	141,684	331,492	48,048
New Brunswick.....	59,773	7,510	106,649	181,941	50,945
Manitoba....	86,735	19,199	82,712	35,838	54,177
British Columbia	44.521	2,631	17,504	49,163	30,764
Prince Edward Island...	37,392	116	45,849	147,372	42,629
The Territories	60,976	7,583	37,003	64,920	16,283

NUMBER OF PURE-BRED CATTLE IN THE UNITED STATES, 1895.

(U. S. Dept. of Agriculture.)

	Registered.	Living.	Average Value.	Total Value.
Ayrshire....	18,750	9,375	$100	$937,500
Brown-Swiss...........	1,930	1,200	150	180,000
Devon................ ...	17,007	14,500	81	1,174.500
Dutch-Belted...........	971	720	200	144,000
Guernsey............ ...	12,547	8,500	165	1,402,500
Holstein-Friesian..	90,325	70,000	100	7,000,000
Jersey	150,000	100,000	100	10,000,000
"Maine State" Jersey..	3,927	2,800	55	154,000
Red Polled	4,408	3,000	80	240,000

STATISTICTS OF BUTTER, CHEESE, AND CONDENSED-MILK FACTORIES IN THE UNITED STATES. (Eleventh Census.)

Totals for the United States.	1890. Butter and Cheese Factories.	1890. Urban Estabs.
Number of establishments reporting.............. ...	4,552	160
Capital employed, aggregate.................. dollars	16,016,573	607,590
Plant, total value.......................... "	11,639,692	449,880
Land .... "	968,333	145,692
Buildings................................. "	5,588,257	150,149
Machinery................................. "	5,083,102	154,039
Live assets .... "	4,376,881	157,710
Expenses, total annual....................... "	813,954	61,228
Employés ....average number	14,369	552
Total wages paid ....dollars	5,116,005	274,700
Earnings of skilled operatives, weekly:		
Average for males above 16 years........... "	9.48	
Average for females above 15 years......... "	5.35	
Average for children .... "	2.75	
Hours of labor, daily average:		
May to November........................ hours	11.09	
November to May .... "	10.03	
Materials used:		
Aggregate cost ....dollars	49,819,301	1,545,273
For butter:		
Gathered cream.........................pounds	483,630,741	
Milk...................................... "	1,893,319,242	
Total cost ....dollars	29,538,827	
For cheese:		
Milk...................................pounds	2,684,550,517	
Total cost.............................dollars	16,953,992	
For condensed milk:		
Milk ....pounds	83,617,655	
Sugar .... "	13,372,365	
Total cost ....dollars	2,792,086	
Fuel and rented power, cost.................. "	534,396	
Products:		
Aggregate value.......................... "	60,635,705	2,050,338
Butter made:		
Quantity ....pounds	181,284,916	
Value ....dollars	36,675,411	
Cheese, full cream:		
Quantity ....pounds	184,158,174	
Value ....dollars	16,112,871	
Cheese, skim:		
Quantity...............................pounds	22,467,132	
Value ....dollars	1,230,297	
Cheese, all other made:		
Quantity...............................pounds	31,409,759	
Value..................................dollars	2,459,783	
Cheese, total made:		
Quantity...............................pounds	238,035,065	
Value..................................dollars	19,802,951	
Condensed milk:		
Quantity...............................pounds	37,926,821	
Value..................................dollars	3,586,927	
Skim-milk and all other products, value .... "	570,416	

CHEESE, BUTTER, AND CONDENSED-MILK FACTORIES, ACCORDING TO STATES.

(Eleventh Census.)

State.	No. of Factories.	Employés.	Value of Products.
New York	1,308	3,075	$14,385,966
Wisconsin	966	1,817	6,960,711
Iowa	497	2,545	10,545,182
Ohio	330	890	3,001,606
Pennsylvania	300	904	5,319,434
Illinois	262	1,540	8,004,991
Vermont	123	310	1,602,641
Minnesota	106	855	2,958,476
Kansas	101	312	919,787
Michigan	100	424	1,179,139
Missouri	61	186	400,551
Nebraska	58	475	1,183,000
Indiana	52	187	402,556
Connecticut	49	162	881,327
Other States	239	687	2,890,338
Total for the United States	4,552	14,369	$60,635,705

DAIRY PRODUCTS PRODUCED ON FARMS, ACCORDING TO THE ELEVENTH CENSUS.

(U. S. Dept. of Agriculture.)

States and Territories.	Butter.	Cheese.	Milk.
	Pounds.	Pounds.	Gallons.
Maine	15,593,315	696,052	57,969,791
New Hampshire	7,942,840	341,235	42,633 268
Vermont	23,314,063	609,586	90,712,230
Massachusetts	8,358,703	122,900	82,571,924
Rhode Island	965,456	24,631	10,610,547
Connecticut	7,196,095	112,566	54,413,822
New York	98,241,813	4,324,028	663,917,240
New Jersey	8,367,218	23,613	64,003,953
Pennsylvania	76,809,041	439,060	368,906,480
Delaware	2,026,498	359	10,699,362
Maryland	9,999,602	9,573	46,601,218
Virginia	17,949,966	109,187	78,143,459
North Carolina	13,129,374	60,760	55,250,665
South Carolina	5,737,557	2,476	23,833,631
Georgia	14,483,323	12,833	52,234,508
Florida	867,195	1,731	5,056,790
Alabama	14,548,435	6,131	55,508,687
Mississippi	12,988,637	4,898	50,803,371
Louisiana	2,089,774	3,930	12,881,927
Texas	32,100,560	145,730	118,475,320
Arkansas	15,724,144	21,328	54,325,673
Tennessee	28,314,389	69,919	107,657,116
West Virginia	14,063,627	74,372	59,449,066
Kentucky	29,038,406	64,822	118,497,289
Ohio	74,990,307	1,068,083	326,925,396
Michigan	50,197,481	328,682	224,537,488
Indiana	48,477,766	360,948	200,510,797
Illinois	57,121,486	343,456	367,269,464
Wisconsin	46,[illegible]05,623	906,266	303,701,134
Minnesota	34,766,409	676,642	182,968,973
Iowa	72,893,079	1,038,358	486,961,411
Missouri	43,108,521	288,620	193,931,103
Kansas	46,117,076	759,210	201,608,099
Nebraska	27,818,078	463,831	144,768,263
South Dakota	13,127,244	303,951	59,666,523
North Dakota	5,712,566	131,374	26,566,112
Montana	1,062,185	11,512	6,038,096
Wyoming	428,269	15,196	3,064,588
Colorado	3,282,086	87,183	19,680,791
New Mexico	86,042	18,931	717,155
Arizona	115,203	10,855	709,225
Utah	1,759,354	163,539	8,614,694
Nevada	489,657	51,207	2,532,052
Idaho	1,078,103	207,213	5,085,863
Washington	3,482,225	71,281	19,873,281
Oregon	4,786,277	265,576	25,042,276
California	26,776,704	3,871,575	111,191,186
Total, 1889	1,023,821,770	18,725,218	5,207,121,309
Total, 1879	777,229,367	27,272,489	529,632,966
Total, 1869	514,088,188	53,492,153	235,374,522

DOMESTIC EXPORTS OF BUTTER AND CHEESE, 1870–95. (U. S. Dept. of Agriculture.)

Year.	Butter.		Cheese.	
	Pounds.	Value.	Pounds.	Value.
1870	2,019,288	$592,229	57,296,327	$8,881,934
1871	3,965,043	853,096	63,698,867	8,752,990
1872	7,746,261	1,498,812	66,204,025	7,752,918
1873	4,518,844	952,919	80,366,540	10,498,010
1874	4,367,983	1,092,381	90,611,077	11,898,995
1875	6,360,827	1,506,996	101,010,853	13,659,603
1876	4,644,894	1,109,496	97,676,264	12,270,083
1877	21,527,242	4,424,616	107,364,666	12,700,627
1878	21,837,117	3,931,822	123,783,736	14,103,529
1879	38,248,016	5,421,205	141,654,474	12,579,968
1880	39,236,658	6,690,687	127,553,907	12,171,720
1881	31,560,500	6,256,024	147,995,614	16,380,248
1882	14,794,305	2,864,570	127,989,782	14,058,975
1883	12,348,641	2,290,665	99,220,467	11,134,526
1884	20,627,374	3,750,771	112,869,575	11,663,713
1885	21,683,148	3,643,646	111,992,990	10,444,409
1886	18,953,990	2,958,457	91,877,235	7,662,145
1887	12,531,171	1,983,698	81,255,994	7,594,633
1888	10,455,651	1,884,908	88,008,458	8,736,304
1889	15,504,978	2,568,765	84,999,828	7,889,671
1890	29,748,042	4,187,489	95,376,053	8,591,042
1891	15,187,114	2,197,106	82,133,876	7,405,376
1892	15,047,246	2,445,878	82,100,221	7,676,657
1893	8,920,107	1,672,690	81,350,923	7,624,648
1894	11,812,092	2,077,608	73,852,134	7,180,331
1895	5,598,812	915,533	60,448,421	5,497,539

EXPORTS OF DAIRY PRODUCTS FROM CANADA, 1868–95. (Statistical Year-book for 1895.)

Year.	Butter.		Cheese.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		Pounds.	
1868	10,649,733	$1,698,042	6,141,570	$620,543
1880	18,535,362	3,058,069	40,368,678	3,893,366
1881	17,649,491	3,573,034	49,255,523	5,510,443
1882	15,161,839	2,936,150	50,807,049	5,500,868
1883	8,106,447	1,705,817	58,041,387	6,451,870
1884	8,075,537	1,612,481	69,755,423	7,251,989
1885	7,330,788	1,430,905	79,655,367	8,265,240
1886	4,668,741	832,355	78,112,927	6,754,626
1887	5,485,509	979,126	73,604,448	7,108,978
1888	4,415,381	798,673	84,173,267	8,928,242
1889	1,780,765	331,958	88,534,887	8,915,684
1890	1,951,585	340,131	94,260,187	9,372,212
1891	3,768,101	602,175	106,202,140	9,508,800
1892	5,736,696	1,056,058	118,270,052	11,652,412
1893	7,036,013	1,296,814	133,946,365	13,407,470
1894	5,534,621	1,095,598	154,977,480	15,488,191
1895	3,650,258	697,476	146,004,650	14,253,002

POULTRY AND EGG PRODUCT IN THE UNITED STATES,

According to the Census of 1880 and 1890.

	1879–1880.	1889–1890.
Poultry on hand June 1. Number.		
Barnyard fowl (chickens)	102,265,653	258,472,155
Geese, ducks, turkeys, etc.	23,234,687	26,816,545
Eggs produced (dozens)	456,875,080	817,211,146

At 12 cents a dozen, a very moderate estimate, the annual value of the egg product on the farm rose from $55,000,000 in 1879 to $98,000,000 in 1889, an increase of 79 per cent. There was an increase of 153 per cent in the number of barnyard fowl during the decade considered, and of other fowl (geese, ducks, turkeys, etc.) an increase of 15 per cent.

IMPORTANCE OF APIARIAN INDUSTRY IN THE UNITED STATES.

(U. S. Department of Agriculture.)

Apiarian societies in the United States	110
Apiarian journals	8
Steam factories for the manufacture of beehives and apiarian implements	15
Persons engaged in the culture of bees (estimated)	300,000
Honey and wax produced, at wholesale rates (eleventh census)	$7,000,000
Estimate of the present annual value of apiarian products	$20,000,000

PRODUCTION OF HONEY AND BEESWAX IN THE UNITED STATES ACCORDING TO CENSUS RETURNS OF 1869, 1879, AND 1889.

	1869	1878	1889
Honey, lbs	14,702,815	25,741,485	63,894,186
Beeswax, lbs	631,129	1,105.556	1.166.543

VI. DIRECTORY.

DIRECTORY OF OFFICIAL AGRICULTURAL INSTITUTIONS.

Organization of the U. S. Department of Agriculture. Washington, D. C.

SECRETARY OF AGRICULTURE—Hon. J. Sterling Morton.*

ASSISTANT SECRETARY OF AGRICULTURE—Chas. W. Dabney, Jr.

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* Term expires March 4, 1897.

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Canada.

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- Dominion Minister of Agriculture, Hon. Sidney Fisher, Ottawa.
- Hon. John Dryden, Toronto, Prov. of Ontario.
- Hon. Louis Beaubien, Quebec, Prov. of Quebec.
- Hon. B. W Chipman, Halifax, Prov. of Nova Scotia.
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- Hon. J. H. Turner, Victoria, Prov. of British Columbia.
- Hon. Thomas Greenway, Winnipeg, Prov. of Manitoba.

EDUCATIONAL INSTITUTIONS IN THE UNITED STATES AND CANADA HAVING COURSES IN AGRICULTURE. (Yearbook U. S. Dept. of Agriculture.)

State.	Name of Institution.	Locality.	President.
Alabama	Agricultural and Mechanical College	Auburn	W. L. Broun.
Arizona	University of Arizona	Tucson	Howard Billman.
Arkansas	Arkansas Industrial University	Fayetteville	J. L. Buchanan.
California	College of Agriculture of the University	Berkeley	M. Kellogg.
Colorado	State Agricultural College	Fort Collins	Alston Ellis.
Connecticut	Storrs Agricultural College	Storrs	B. F. Koons.
	Sheffield Scientific School of Yale University	New Haven	Timothy Dwight.
Delaware	Delaware College	Newark	Geo. A. Harter.
	State College for Colored Students	Dover	W. C. Jason.
Florida	State Agricultural and Mechanical College	Lake City	O. Clute.
	Florida State Normal School	Tallahassee	T. De S Tucker.
Georgia	College of Agriculture and Mechanical Arts	Athens	H. C. White.
Idaho	College of Agriculture of the University	Moscow	F. B. Gault.
Illinois	College of Agriculture of the University	Urbana	A. S. Draper.
Indiana	School of Agriculture, Horticulture, and Veterinary Science of Purdue University	Lafayette	J. H. Smart.
Iowa	College of Agriculture and Mechanical Arts	Ames	W. M. Beardshear.
Kansas	Kansas State Agricultural College	Manhattan	Geo. T. Fairchild.
Kentucky	Agricultural and Mechanical College	Lexington	J. K. Patterson.
	State Normal School	Frankfort	J. H. Jackson.
Louisiana	State University and Agricultural and Mechanical College	Baton Rouge	J. W. Nicholson.
	Southern University and Agricultural and Mechanical College	New Orleans	H. A. Hill.
Maine	Maine State College	Orono	A. W. Harris.
Maryland	Maryland Agricultural College	College Park	R. W. Silvester.
Massachusetts	Massachusetts Agricultural College	Amherst	H. H. Goodell.
Michigan	Michigan Agricultural College	Agricultural College	J. L. Snyder.

Minnesota	College of Agriculture of the University	Minneapolis	Cyrus Northrop.
Mississippi	Agricultural and Mechanical College	Agricultural College	S. D. Lee.
	Alcorn Agricultural and Mechanical College	Westside	T. J. Calloway.
Missouri	College of Agriculture and Mechanical Arts of the University.	Columbia	Richard H. Jesse.
Montana	College of Agriculture and Mechanical Arts	Bozeman	James Reid.
Nebraska	Industrial College of the University	Lincoln	G. E. MacLean.
Nevada	School of Agriculture of the University	Reno	J. E. Stubbs.
New Hampshire.	College of Agriculture and Mechanical Arts	Durham	C. S. Murkland.
New Jersey	Rutgers Scientific School	New Brunswick	Austin Scott.
New Mexico	College of Agriculture and Mechanical Arts.	Mesilla Park	C. T. Jordan.
New York	Cornell University	Ithaca	J. G. Schurman.
North Carolina	College of Agriculture and Mechanical Arts	Raleigh	A. Q. Holliday.
North Dakota	North Dakota Agricultural College	Fargo	J. H. Worst.
Ohio	Ohio State University	Columbus	J. H. Canfield.
Oklahoma	Agricultural and Mechanical College.	Stillwater	G. E. Morrow.
Oregon	Oregon State Agricultural College	Corvallis	John M. Bloss.
Pennsylvania	Pennsylvania State College	State College	Geo. W. Atherton.
Rhode Island	College of Agriculture and Mechanical Arts	Kingston	J. H. Washburn.
South Carolina	Clemson Agricultural College	Clemson College	E. B. Craighead.
	College of Agriculture and Mechanics' Institute of Claflin University	Orangeburg	L. M. Dunton.
South Dakota	South Dakota Agricultural College	Brookings	J. W. Heston.
Tennessee	State Agricultural and Mechanical College	Knoxville	C. W. Dabney, Jr.
Texas	State Agricultural and Mechanical College	College Station	L. S. Ross.
	Prairie View State Normal School	Prairie View	L. C. Anderson.
Utah	Agricultural College of Utah	Logan	J. M. Tanner.
Vermont	State Agricultural College of the University	Burlington	M. H. Buckham.
Virginia	Agricultural and Mechanical College	Blackburg	J. M. McBryde.
	Hampton Normal and Agricultural Institute	Hampton	H. B. Frissell.
Washington	Agricultural College and School of Science	Pullman	E. A. Bryan.
West Virginia	West Virginia University	Morgantown	J. L. Goodknight.
	West Virginia Colored Institute	Farm	J. H. Hill.
Wisconsin	College of Agriculture of the University	Madison	C. K. Adams.
Wyoming	College of Agriculture of the University	Laramie	F. P. Graves.
Ontario, Canada.	Ontario Agricultural College	Guelph	James Mills.

STATISTICS OF AGRICULTURAL SCHOOLS AND COLLEGES IN THE UNITED STATES.

(U. S. Department of Agriculture.)

State.	Date of Establishment of Agricultural Department.	Number in Faculty.	Students in 1894.	Students in Agricultural Courses in 1894.	Graduates in Agricultural Courses in 1894.	Total Number of Graduates in Agricultural Courses.	Tuition fees.	
							Residents of State.	Non-residents.
Alabama (Auburn)	1872	25	254	135	12	83	$5	$5
Arizona	1891	9	47	0	0	0	0	0
Arkansas	1872	35	615	33	1	0	0	10
California	1868	65	1030	158	3	33	0	0
Colorado	1878	23	219	58	4	21	0	0
Conn. (New Haven)	1846	57	662	111	0	13	165	......
Connecticut (Storrs)	1881	10	145	122	10	108	25	......
Delaware (Newark)	1870	12	75	6	0	1	0	60
Delaware (Dover)	1892	3	30	......	......	......	0	30
Florida (Lake City)	1884	18	187	5	0	4	0	20
Florida (Tallahassee)	1890	9	55	55	0	0	0	0
Georgia (Athens)	1872	15	106	83	2	267	0	0
Idaho	1892	12	175	10	......	......	0	0
Illinois	1868	56	743	33	1	......	0	0
Indiana	1874	48	682	63	3	21	0	100
Iowa	1869	42	614	175	4	242	0	0
Kansas	1874	32	460	460	39	370	0	0
Kentucky (Lexington)	1880	25	297	1	0	0	20	20
Kentucky (Frankfort)	1892	6	36	10	0	0	......	......
Louisiana (Baton Rouge)	1887	20	196	15	1	22	0	0
Louisiana (New Orleans	1890	13	304	23	0	1	0	0
Maine	1868	23	192	14	2	......	0	0
Maryland	1859	11	141	15	5	......	24	24
Massachusetts	1867	20	204	204	34	417	0	80
Michigan	1855	29	260	181	14	623	0	15
Minn. (Minneapolis)	1869	139	2,000	175	20	86	5	5
Mississippi (Agricultural College)	1880	23	302	216	8	166	5	25
Mississippi (Westside)	1878	15	310	310	6	79	0	15
Missouri (Columbia)	1870	18	46	2	3	......	20	20
Montana	1893	8	137	15	......	......	10	10
Nebraska	1869	[1]181	[1]1,420	19	1	96	0	0
Nevada	1888	15	253	6	0	2	0	0
New Hampshire	1866	14	93	27	1	30	60	60
New Jersey	1865	28	143	3	0	11	[2]85	[2]85
New Mexico	1890	17	150	3	3	3	......	......
New York	1865	151	2,031	106	......	15	{ 125 100	125 100
North Carolina (Raleigh)	1889	18	225	31	2	7	20	20
North Dakota	1890	13	61	8	0	0	2	5
Ohio	1873	77	749	89	3	29	15	15
Oklahoma	1892	8	120	49	0	0	0	0
Oregon	1888	20	237	47	4	16	15	15
Pennsylvania	1859	47	3'7	34	0	53	0	100
Rhode Island	[illegible]	[illegible]	[illegible]	60	12	12	0	3

STATISTICS OF AGRICULTURAL SCHOOLS AND COLLEGES IN THE UNITED STATES.—(*Continued.*)

State.	Date of Establishment of Agricultural Department.	Number in Faculty.	Students in 1894.	Students in Agricultural Courses in 1894.	Graduates in Agricultural Courses in 1894.	Total Number of Graduates in Agricultural Courses.	Tuition fees.	
							Residents of State.	Non-residents.
South Carolina (Clemson College...	1893	20	635	122	0	0	$40	$40
South Carolina (Orangeburg)	1872	22	450	146	0	10	0	0
South Dakota..........	1884	25	162	20	3	45	9	15
Tennessee.............	1869	20	203	31	0	.....	0	0
Texas (College Station)	1871	22	368	187	7	47	0	0
Utah.....	1889	20	350	37	1	1	5	5
Vermont...	1885	23	379	86	1	4	60	60
Virginia (Blacksburg)..	1872	18	325	70	1	......	30	30
Virginia (Hampton)....	1890	76	159	54	......	.....	0	0
Washington	1892	12	176	15	0	1	0	0
West Virginia (Morgantown...	1868	15	250	11	1	2	0	12.50
West Virginia (Farm)..	1892	5	70	0	0	0	0	0
Wisconsin....	1866	27	[1]1,598	190	20	62	0	18
Wyoming..............	1891	10	[3]33	0	0	0	0	0
Total	.	1643	21,195	3,847	229	3,003	......	......

[1] In universities. [2] Includes incidentals. [3] New.

LIST OF AMERICAN VETERINARY COLLEGES.

NATIONAL VETERINARY COLLEGE, Washington, D. C.: *Dr. D. E. Salmon*, Pres.; Dr. Chas. F. Dawson, Sec.

VETERINARY DEPARTMENT, UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pa.: *John Marshall*, M.D., Dean.

AMERICAN VETERINARY COLLEGE, UNIVERSITY OF THE STATE OF NEW YORK, New York City: *Dr. A. Liautard*, M.D., Principal and Dean.

SCHOOL OF VETERINARY MEDICINE, HARVARD UNIVERSITY, Boston, Mass.: *Chas. P. Lyman*, F.R.C.V.S., Dean.

VETERINARY COLLEGE, CORNELL UNIVERSITY, Ithaca, N. Y.: *Prof. J. Law*, Dean.

SCHOOL OF VETERINARY MEDICINE, OHIO STATE UNIVERSITY, Columbus, O.: *W. R. Lazenby*, Secretary.

CHICAGO VETERINARY COLLEGE, Chicago, Ill.: *Johs. Hughes*, M.R.C.V.S., Principal.

MCKILLIP VETERINARY COLLEGE, Chicago, Ill.: *M. H. McKillip*, M.D., V.S., President.

CALIFORNIA VETERINARY COLLEGE, San Francisco, Cal.: *Dr. Thomas Bonhill*, Dean.

ONTARIO VETERINARY COLLEGE, Toronto, Canada: *Dr. A. Smith*. F.R.C.V.S., Principal.

DAIRY SCHOOLS IN THE UNITED STATES AND CANADA.

State or Province.	Location.	Name of Director, Superintendent, or Professor in Charge.
Maine	Orono	Prof. Chas. D. Woods
New Hampshire	Durham	Prof. F. Wm. Rane
Vermont	Burlington	Prof. J. L. Hills
Massachusetts	Amherst	Prof. Wm. Brooks
New York	Ithaca	Prof. H. H. Wing
Pennsylvania	State College	Prof. Geo. C. Watson
Virginia	Blacksburg	Prof. J. M. McBryde
Ohio	Columbus	Prof. Thos. F. Hunt
Michigan	Agricultural College	Clinton D. Smith
Illinois	Urbana	Prof. E Davenport
Wisconsin	Madison	Prof. E. H. Farrington
Minnesota	St. Anthony Park	Prof. T. L. Haecker
Iowa	Ames	Prof. James Wilson.
Missouri	Columbia	Prof. H. J. Waters
North Dakota	Fargo	Prof. E. E. Kaufman
South Dakota	Brookings	Prof. J. N. Trueman
Utah	Logan	Prof. F. B. Linfield
Washington	Pullman	Prof. W. J. Spillman
Ontario	Kingston	J. H. Ruddick, Supt.
"	Guelph	Prof. H H. Dean
"	Strathroy	F. J. Sleightbom, Supt.
Quebec	St. Hyacinthe	E. Castel, Principal
New Brunswick	Sussex	J. E. Hopkins
Nova Scotia	Nappan	W. S. Blair, Supt.
Winnipeg	Manitoba	C. C. McDonald, Supt.

Canadian Experiment Stations.

Central Experimental Farm—Wm. Saunders, *Director.*

Experimental Farm—Nappan, N. S.; W. M. Blair, *Superintendent.*

" " Brandon, Manitoba; S. A. Bedford, *Superintendent.*

" " Indian Head, N. W. T.; Angus MacKay, *Superintendent.*

" " Agassiz, B. C.; Thos. A. Sharpe, *Superintendent.*

Experiment Station — Ontario Agricultural College, Guelph, Ont.; James Mills, *President.*

LIST OF AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

State.	Location.	Director.	Year Established.
Alabama (College)....	Auburn	W. L. Broun	1883
Alabama (Canebrake)	Uniontown	H. Benton	1886
Arizona..............	Tucson	W. S. Devol	1889
Arkansas	Fayetteville	R. L. Bennett	1887
California............	Berkeley	E. W. Hilgard	1873
Colorado.............	Fort Collins	Alston Ellis	1879
Connecticut (State)..	New Haven	S. W. Johnson	1877
Connecticut (Storrs)..	Storrs	W. O. Atwater	1887
Delaware...	Newark	A. T. Neale	1888
Florida	Lake City	O. Clute	1888
Georgia......	Experiment	R. J. Redding	1888
Idaho................	Moscow	C. P. Fox	1892
Illinois.	Urbana	E. Davenport	1888
Indiana	Lafayette	C. S. Plumb	1888
Iowa.................	Ames	James Wilson	1888
Kansas.	Manhattan	Geo. T. Fairchild	1888
Kentucky.......	Lexington	M. A. Scovell	1885
Louisiana (Sugar)....	New Orleans	W. C. Stubbs	1885
Louisiana (State)	Baton Rouge	W. C. Stubbs	1886
Louisiana (North)....	Calhoun	W. C. Stubbs	1887
Maine	Orono	Chas. D. Woods	1885
Maryland...	College Park	R. H. Miller	1888
Massachusetts........	Amherst	H. H. Goodell	1882
Michigan...	Agricultural College	C. D. Smith	1888
Minnesota......... ..	St. Anthony Park	W. M. Liggett	1888
Mississippi...... ...	Agricultural College	S. M. Tracy	1888
Missouri.............	Columbia	H. J. Waters	1883
Montana.............	Bozeman	S. M Emery	1893
Nebraska	Lincoln	Geo. E. McLean	1884
Nevada..	Reno	J. E. Stubbs	1888
New Hampshire. ..	Durham	C. S. Murkland	1886
New Jersey (State)...	New Brunswick	E. B. Voorhees	1880
New Mexico........	Mesilla Park	C. T. Jordan	1889
New York (State)...	Geneva	W. H. Jordan	1882
New York (Cornell)..	Ithaca	I. P. Roberts	1879
North Carolina	Raleigh	H. B. Battle	1877
North Dakota..	Fargo	J. H. Worst	1890
Ohio	Wooster	C. E. Thorne	1882
Oklahoma............	Stillwater	G. E. Morrow	1890
Oregon	Corvallis	H. B. Miller	1888
Pennsylvania	State College	H. P. Armsby	1887
Rhode Island	Kingston	C. O. Flagg	1888
South Carolina.... ..	Clemson College	E. B. Craighead	1888
South Dakota........	Brookings	J. H. Shepard	1887
Tennessee............	Knoxville	C. F. Vanderford	1882
Texas.	College Station	J. H. Connell	1888
Utah................	Logan	Luther Foster	1890
Vermont.....	Burlington	J. L. Hills	1886
Virginia	Blacksburg	J. M. McBryde	1888
Washington	Pullman	E. A. Bryan	1891
West Virginia	Morgantown	J. A. Myers	1888
Wisconsin......	Madison	W. A. Henry	1883
Wyoming..	Laramie	F. P. Graves	1891

VI. AGRICULTURAL AND DAIRY LITERATURE.

MORE IMPORTANT WORKS ON DAIRYING.

American.

Arnold, American Dairying. Rochester, N. Y., 1876. (Out of print.)

Decker, Cheddar Cheese Making. Second edition. Madison, Wis., 1895. 151 pp. $1.00.

Flint, Milch Cows and Dairy Farming. Boston, 1888.

Georgeson, Dairy Industry of Denmark. Washington, D. C., 1893. 133 pp.

Grotenfelt-Woll, Modern Dairy Practice. Second edition. New York, 1895. 285 pp. $2.00.

Gurler, American Dairying. Chicago, 1894. $1.00.

Harris, Cheese and Butter Maker's Handbook. Glasgow, 1885. 207 pp.

Jones, Mrs. E. M., Dairying for Profit. Chicago, 1893. 63 pp. 50 cents.

Monrad, The Dairy Messenger. Winnetka, Ill., 1890–93. 242 pp. $1.25.

Monrad, A B C in Cheese Making. Winnetka, Ill. Second edition. 68 pp. 50 cents.

Monrad, Pasteurization and Milk Preservation. Winnetka, Ill. 78 pp. 50 cents.

Monrad, Cheese Making in Switzerland. Winnetka, Ill. 68 pp. 50 cents.

Newell, Handbook on Cheese Making. Grand Rapids, Mich., 1889. 59 pp. 50 cents.

Russell, Outlines of Dairy Bacteriology. Madison, Wis., 1893. 186 pp. $1.00.

Schoenman, Milk Testing. Madison, Wis., 1894. 39 pp. 75 cents.

Schoenman, Butter-fat and Dividend Calculator. Madison, Wis., 1895. 66 pp. $2.00.

Stewart, Dairyman's Manual. N. Y., 1888. 475 pp.

Willard, Practical Dairy Husbandry. N. Y., 1877. 546 pp.

Willard, Practical Butter Book. N. Y., 1883. 171 pp.

English.

Fleischmann, Book of the Dairy. London, 1896. 10s. 6d.

Sheldon, Dairy Farming. London. 570 pp., 4to.

Sheldon, The Farm and the Dairy. London, 1889. 154 pp. 2s. 6d.

Sheldon, British Dairying. 2d ed., 1896. 170 pp.

Long, The Dairy Farm. London, 1889. 115 pp.

Long and Morton, The Dairy. London. 146 pp.

Oliver, Milk, Cheese, and Butter. London, 1894. 362 pp.

Other European.

Böggild, Mälkeriebruget i Danmark. Second edition. Copenhagen, 1896. 627 pp.

Martiny, Die Milch, I–II. Danzig, 1871. 438 and 366 pp.

Martiny, Kirne und Girbe. Berlin, 1895. 404 pp., 4to.

Martiny, Milchwirtschaftl. Taschenbuch. Published annually. Bremen.

Fleischmann, Das Molkereiwesen. Braunschweig, 1876, 1074 pp.

Fleischmann, Lehrbuch d. Milchwirtschaft. Bremen, 1893. 368 pp.

Kirchner, Handbuch d. Milchwirtschaft. Bremen, 1891. 618 pp.

v. Klenze, Handbuch d. Käserei-Technik. Bremen, 1884. 643 pp.

Eugling, Praktische Käserei. Bremen, 1892. 260 pp.

Weigmann, Die Methoden der Milch-conservirung. Bremen, 1893. 72 pp.

Duclaux, Le Lait. Paris, 1887. 336 pp.

Duclaux, Principes de Laiterie. Paris. 370 pp.

Lézé, Les Industries du Lait. Paris, 1891. 647 pp.

Pouriau, La Laiterie, 5th ed. Paris, 1895. 898 pp.

A LIST OF FIFTY AGRICULTURAL AND HORTICULTURAL BOOKS.

Fream, Elements of Agriculture. 4th ed. London, 1892. 486 pp.

Webb, Advanced Agriculture. London, 1894. 672 pp.

Mills and Shaw, Public School Agriculture. Toronto, 1890. 250 pp.

Wallace, Agriculture. Philadelphia, 1895. 352 pp.

Gulley, First Lessons in Agriculture. N. Y., 1892. 155 pp.

Winslow, Principles of Agriculture. N. Y., 1891. 152 pp.

Storer, Agriculture in some of its Relations with Chemistry. 4th ed. N. Y., 1892. 2 vols. 551 and 590 pp.

Voorhees, First Principles of Agriculture. N. Y., 1896. 212 pp.

Warington, Chemistry of the Farm. 7th ed. London. 160 pp.

Johnson, How Crops Feed. N. Y. 375 pp.

Johnson, How Crops Grow. N. Y., 1890. 416 pp.

Morrow and Hunt, Soils and Crops of the Farm. Chicago, 1892. 303 pp.

Plumb, Indian Corn Culture. Chicago, 1895. 243 pp.

Woll, A Book on Silage. Chicago, 1896. 190 pp.

Allen, American Cattle. N. Y., 1881. 528 pp.

Wallace, Farm Live Stock. Edinburgh, 1889. 333 pp.

McDonald, Cattle, Sheep, and Deer. 5th ed. London, 1872. 745 + 91 pp.

Warfield, Cattle Breeding. Chicago, 1890. 390 pp.

Day, The Horse, How to Breed and Rear Him. 2d ed. London, 1890. 453 pp.

Curtis, Horses, Cattle, Sheep, and Swine. College Station, Texas, 1888. 269 pp.

Armsby, Manual of Cattle Feeding. N. Y., 1887. 525 pp.

Wolff, Farm Foods, transl. by Cousins. London, 1895. 365 pp.

Stewart, Feeding Animals. 5th ed. Lake View, N. Y., 1890. 558 pp.

Randall, Practical Shepherd. N. Y. 452 pp.

Coburn, Swine Husbandry. N. Y., 1888. 311 pp.

Harris, On the Pig. N. Y., 1889. 318 pp.

Collingwood, The Business Hen. N. Y., 1892. 150 pp.

L. Wright, Book of Poultry. London, 1891. 591 pp.

Cook, Bee-keeper's Guide. Lansing, Mich., 1884. 4th ed. 337 pp.

Law, Farmer's Veterinary Adviser. Ithaca, N. Y., 1880. 426 pp.

King, The Soil. N. Y., 1895. 303 pp.

Waring, Drainage for Profit and Health. N. Y. 252 pp.

Miles, Land Drainage. N. Y., 1893. 199 pp.

Poore, Rural Hygiene. London, 1893. 321 pp.

Wilcox, Irrigation Farming. N. Y., 1895. 311 pp.

Crozier and Henderson, How the Farm Pays. N. Y., 1884. 400 pp.

Bailey, The Horticulturist's Rule Book. 3d ed. N. Y., 1896. 302 pp.

Bailey, The Nursery Book. 2d ed. N. Y., 1892. 304 pp.

Barry, Fruit Garden. N. Y., 1889. 516 pp.

Landreth, Market Gardening and Farm Notes. N. Y., 1893. 215 pp.

Fuller, Small Fruit Culturist. N. Y., 1888. 298 pp.

Fuller, Grape Culturist. N. Y. 281 pp.

Henderson, Practical Floriculture. N. Y., 1891. 325 pp.

Weed, Insects and Insecticides. Hanover, N. H., 1891. 281 pp.

Lodeman, Spraying of Plants. N. Y., 1896. 399 pp.

Fuller, Practical Forestry. N. Y., 1891. 299 pp.

Jarchow, Forest Planting. N. Y., 1893. 237 pp.

Barn Plans and Outbuildings. Orange Judd Co., N. Y., 1893. 235 pp.

Sanders, Practical Hints on Barn Building. Chicago, 1893. 284 pp.

Bennett, Farm Law. Portland, Me., 1880. 120 pp.

AMERICAN DAIRY PAPERS.

American Cheese-Maker. Grand Rapids, Mich. Monthly, 50 cents.

American Dairyman. New York City. Weekly, $1.50.

Bulletin American Devon Cattle Club. Wheeling, W. Va. Monthly, 50 cents.

Chicago Produce. Chicago, Ill. Weekly, $1.50.

Creamery Gazette. Des Moines, Iowa. Monthly, $1.00.

Creamery Journal. Waterloo, Ia. Monthly, $1.00.

Creamery Patron. Decorah, Iowa.

Dairy World. Chicago, Ill. Monthly, $1.00.

Elgin Dairy Report. Elgin, Ill. Weekly, $1.00.

Jersey Bulletin. Indianapolis, Ind. Weekly, $2.00.

Hoard's Dairyman. Fort Atkinson, Wis. Weekly, $1.00.

Holstein-Friesian Register. Brattleboro, Vt. Semi-monthly, $1.50.

The Milk News. Chicago, Ill. Monthly, $1.00.

The Milk Reporter. Deckertown, N. Y. Monthly, $1.00.

New York Produce Review and American Creamery. New York City. Weekly. $1.00.

The Pacific Coast Dairyman. Tacoma, Wash. Semi-monthly, $1.00.

The Practical Dairyman. Chatham, N. Y. Monthly, 50 cents.

The Western Creamery. San Francisco, Cal. Monthly, $1.00.

MAIN FOREIGN DAIRY PAPERS.

The Dairy. 144 Fleet Street, London, England. Monthly, 3s.

The Dairyman. 17 New Castle Street, Farringdon St., London, England.

The Dairy World and British Dairy Farmer. 310 Strand, London, England. Monthly, 3s.

Nordisk Mejeri-Tidning. Stockholm, Sweden. Weekly, 5 kr.

Mälkeritidende. Odense, Denmark. Weekly.

Milch-Zeitung. Bremen, Germany. Weekly, 8 mk.

Deutsche Molkerei-Zeitung. Berlin, Germany. Weekly, 8 mk.

Molkerei-Zeitung. Hildesheim, Germany. Weekly, 6 mk.

L'Industrie Laitière 33 Rue J. J. Rousseau, Paris, France. Weekly, 20 fr.

La Laiterie. 18 Rue des Martyrs. Paris. Bi-weekly, 13. fr.

Schweizerische Molkerei Zeitung. Zurich. Weekly, 6.60 fr.

Die Milch Industrie. Berne, Switzerland.

MAIN AMERICAN AGRICULTURAL AND HORTICULTURAL PAPERS.

Agricultural Epitomist. Indianapolis, Ind. Monthly, 50 cents.

American Agriculturist. New York City. Weekly, $1.00.

American Bee Journal. Chicago, Ill. Weekly, $1.00.

American Cultivator. Boston, Mass. Weekly, $2.50.

American Farmer. Chicago, Ill. Semi-monthly, 50 cents.

American Fertilizer. Philadelphia, Pa. Monthly, $2.00.

American Gardening. New York City. Semi-monthly, $1.00.

American Grange Bulletin. Cincinnati, O. Weekly, $1.00.

American Poultry Journal. Chicago, Ill. Monthly, $1.00.

American Poultry Yard. Hartford, Conn. Weekly, $1.50.

American Sheep Breeder and Wool Grower. Chicago, Ill. Monthly, $1.00.

American Swine Herd. Chicago, Ill. Monthly, 50 cents.

American Veterinary Review. New York City. Monthly, $3.00

Acker und Gartenbau Zeitung. Chicago, Ill. Weekly, $1.00.

Breeders' Gazette. Chicago, Ill. Weekly, $2.00.

Breeders' Journal. Beecher, Ill. Monthly, $1.00.

California Cultivator and Poultry Keeper. Los Angeles, Cal. Monthly, $1.00.

Colman's Rural World. St. Louis, Mo. Weekly, $1.00.

Colorado Farmer. Denver, Colo. Weekly, $2.00.

Connecticut Farmer. Hartford, Conn. Weekly, $1.50.

The Cultivator and Country Gentleman. Albany, N. Y. Weekly, $2.50.

The Cultivator. Omaha, Neb. Semi-monthly, 50 cents.

The Dakota Farmer. Aberdeen, S. D. Semi-monthly, $1.00.

Farm and Fireside. Springfield, O. Semi-monthly, 50 cents.

Farm and Home. Chicago and Springfield, Mass. Semi-monthly, 50 cents.

The Farmers' Advocate. London, Ont. Semi-monthly, $1.00.

Farmer's Call. Quincy, Ill. Weekly, 50 cents.

Farmers' Review. Chicago, Ill. Weekly, $1.25.

Farmers' Home. Dayton, O. Weekly, 50 cents.

The Farmers' Magazine. Springfield, Ill. Monthly, $2.00.

Farm, Field, and Fireside. Chicago, Ill. Weekly, $1.00.

Farm, Field, and Stockman. Chicago, Ill. Weekly, $1.00.

Farm News. Springfield, Ohio. Monthly, 50 cents.

Farm, Stock, and Home. Minneapolis, Minn. Semi-monthly, 50 cents.

Farming. Toronto, Canada. Monthly, $1.00.

The Farm Journal. Philadelphia, Pa. Monthly, 50 cents.

Florida Agriculturist. De Land, Fla. Weekly, $2.00.

Garden and Forest. New York City. Weekly, $4.00.

Gardening. Chicago, Ill. Semi-monthly, $2.00.

Horse Review. Chicago, Ill. Weekly, $2.00.

Indiana Farmer. Indianapolis, Ind. Weekly, $1.00.

Industrial American. Lexington, Ky. Semi-monthly, $1.00.

Industrialist. Manhattan, Kan. Weekly, 50 cents.

Iowa Farmer. Cedar Rapids, Ia. Monthly, 50 cents.

Iowa Homestead. Des Moines, Ia. Weekly, $1 00.

Irrigation Age. Chicago, Ill. Monthly, $2.00.

Journal of Agriculture. St. Louis, Mo. Weekly, $1.00.

Journal of Agriculture Illustrated. Montreal, Canada. Monthly, $1.00.

Kansas Farmer. Topeka, Kan. Weekly, $1.00.

Kentucky Stock Farm. Lexington. Ky. Weekly, $2.00.

Live Stock Indicator. Kansas City, Mo. Weekly, $1.00.

Live Stock and Farm Journal. Toronto, Canada. Monthly, $1.00.

Live Stock Report. Chicago, Ill. Weekly.

Live Stock Review. Chicago, Ill. Weekly, $2.00.

Louisiana Planter and Sugar Manufacturer. New Orleans, La. Weekly, $3.00.

Maryland Farmer. Baltimore, Md. Monthly, 50 cents.

Meehan's Monthly. Germantown, Pa. Monthly, $2.00

Michigan Farmer. Detroit, Mich. Weekly, $1.00.

Midland Poultry Journal. Kansas City, Mo. Monthly, 50 cents.

Mirror and Farmer. Manchester, N. H. Weekly, $1.00.

Montana Stockman and Farmer. Helena, Mont. Weekly, $2.00.

National Stockman and Farmer. Pittsburgh, Pa. Weekly, $1 50.

Nebraska Farmer. Lincoln, Neb. Weekly, $1.25.

Nebraska Homestead. Omaha, Neb. Weekly, $2.00.

New England Farmer. Boston, Mass. Weekly, $2.00.

New England Homestead. Springfield, Mass. Weekly, $1.00.

Northwestern Agriculturist. Minneapolis, Minn. Semi-monthly, 50 cents.

Northwestern Farmer. St. Paul, Minn. Semi-monthly, 50 cents.

Ohio Farmer. Cleveland, Ohio. Weekly, $1.00.

Ohio Poultry Journal. Dayton, Ohio. Monthly, $1.00.

Orange Country Farmer. Port Jervis, N. Y. Weekly, $1.00.

Orange Judd Farmer. Chicago, Ill. Weekly, $1.00.

Pacific Rural Press. San Francisco, Cal. Weekly, $3.00.

Poultry Monthly. Albany, N. Y. Monthly, $1.25.

Poultry World. Hartford, Conn. Monthly, $1.25.

Practical Farmer. Philadelphia, Pa. Weekly, $1.00.

Prairie Farmer. Chicago, Ill. Weekly, $1.00.

Rural Canadian. Toronto, Canada. Monthly, $1.00.

Rural Californian. Los Angeles, Cal. Monthly, $1.50.

Rural Life. Waterloo, Ia. Weekly, $1.00.

Rural New Yorker. New York City. Weekly, $1.00.

Skördemannen (Swedish). Minneapolis, Minn. Semi-monthly, 75 cents.

Southern Cultivator. Atlanta, Ga. Monthly, $1.00.

Southern Live Stock Journal. Starkville, Miss. Weekly, $1.00.

Southern Planter. Richmond, Va. Monthly, $1.00.

Swine-Breeders' Journal. Indianapolis, Ind. Semi-monthly, $1.00.

Texas Farm and Ranch. Dallas, Tex. Weekly, $1.00.

Texas Stockman. San Antonio, Tex. Weekly, $2.00.

Turf, Field, and Farm. New York City. Weekly, $5.00.

Wallace's Farmer. Des Moines, Ia. Weekly, $1.00.

Western Agriculturist and Live Stock Journal. Quincy, Ill. Semi-monthly, $1.00.

Western Resources. Lincoln, Neb. Weekly, $2.00.

Western Rural. Chicago, Ill. Weekly, $1.00.

Western Swine Herd. Geneseo, Ill. Monthly, 50 cents.

Williamette Farmer. Salem, Ore. Weekly, $2.00.

Wisconsin Agriculturist. Racine, Wis. Semi-monthly, 50 cents.

Wisconsin Farmer. Madison, Wis. Weekly, $1.00.

Wool Markets and Sheep. Chicago, Ill. Weekly, $1.00.

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